DIFFERENCES BETWEEN TEACHERS' AND STUDENTS' PERCEPTIONS OF LEARNING EXPECTATIONS AND THEIR EFFECTS UPON ACHIEVEMENT IN ALGEBRA

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An abstract of a Dissertation by
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The problem. This study was conducted to examine whether differences existed between the perceptions of algebra teachers and algebra students.

Procedures. Inventories comprised of forty questions related to classroom tasks were sent to teachers and students to obtain their perceptions. Means were calculated for each question and the Hotelling's T^2 was conducted on three of the hypotheses. The fourth hypothesis was tested, utilizing the Pearson Product-Moment Correlation.

Findings. Treated data indicated that there was significant difference between teachers and students in their perceptions of classroom activities. Students did not perceive what the teachers perceived. Significant differences exist in the perceptions of male and female students as to the teacher's expectations. Males had higher means than the females, concluding that male perceptions were closer to the teachers' perceptions. Findings indicated that there was not a significant difference in the achievement of males or females.

Conclusions. Differences were found to exist in the perceptions of teachers and students. Conclusions drawn from this study include: (1) Students and teachers do have different perceptions of what takes place in the classroom. Students do not perceive activities and other functions to be as important as the teacher. (2) Male and female students have different perceptions of the teacher's expectations. (3) Achievement was effected as it related to students' perceptions of teacher expectations; however, it was a negative correlation in that students who received high grades did not perceive the expectations. (4) The sex of the student did not have a bearing on achievement.

Recommendations. The goal of schools and universities should be training and educating the staff in the art of teaching and communication, conducting teacher training or in-service programs, reviewing the curriculum, and placing emphasis on the skills necessary to work with students in the process of learning. Teachers must take into account when planning their classes that effective teachers know their students' abilities, skills, and perceptions. Teachers must plan appropriate learning activities for the student for maximum achievement.

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CHAPTER ONE

Introduction

The interaction between teacher and learner is a critical aspect of the instructional program. Though research has been conducted that provides some useful data to assist educators in improving the curriculum, it does not precisely indicate how this process has affected instruction as it is interwoven into the strata of the individual algebra classroom.

Educators, parents, researchers, and, in many cases, students are questioning whether schools are providing a "good" education, one that is adequate to meet the myriad needs demanded in the complexities of society. The concerns about quality education are reflected in the growing emphasis upon minimal competency in the core or skill areas of the educational curriculum. State-required competency testings have arisen in several states, and an interest in federal standards has been expressed. Additionally, there is a "back to the basics" movement stressing academics and discipline thus advocating elimination of non-academic educational pursuits, such as survival skills, insurance awareness, copying skills, crafts, and other similar courses,

not to mention limiting vocational related courses.

Observations indicate that a contributing factor to the unrest or negative disposition of the public toward its schools, curriculums, and staffs is the inability of the classroom teacher to perceive how learning is a result of the daily interaction between students, his/her physical environment, and the verbal and nonverbal communications in the classroom. Students do not think like adults. They view the world from a different perspective; they solve problems by applying a qualitatively different form of thought. This has been supported by Piaget, Benner (1966), Ginsberg (1977), Rohwer (1970), Lindvall and Ibarra (1980). The learner who does not perceive well, most likely will do poorly in a particular subject and may even receive failing grades, or show little achievement. Conversely, the student who perceives what the teacher's learning expectations are will generally be successful.

Lindvall and Ibarra stated "that children are not always able to give meaning to formal, arbitrary symbolism of mathematics."[1] Grouws noted, "that student errors were largely noncomputational and indicated that many children

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[1]C. M. Lindvall and Cheryl Gibbons Ibarra, "Incorrect Procedures Used by Primary Grade Pupils in Solving Open Addition and Subtraction Sentences," Journal for Research in Mathematics Education, 11 (1980), 50-62.

did not understand the meaning of the equation."[1]

If instruction is going to build on children's knowledge and the problem-solving strategies they have previously developed in algebra, teachers need to be aware how children think about algebra. This is supported by Bruner and Rohwer in their research in which they found that prescription programs do not immediately follow the description of the student's thinking.[2] Thus, it can be difficult for the classroom teacher to prescribe the most suitable curriculum for each algebra student from their perceptions of the student's thinking alone and it is critical to know the style and perceptions of the learner. Therefore, as espoused by Crary: "...the school must regard the human worth of each student as its full trust. Nothing less than full commitment to each child is its burden, and failure in this intent is betrayal."[3] It behooves the school and teaching staff, therefore, to examine all aspects of the teaching/learning process to enhance the educational growth of the student.

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[1]Douglas A. Grouws, "Open Sentences: Some Instructional Considerations from Research," Arithmetic Teacher, 19 (1972), 595-99.

[2]Jerome S. Bruner, Toward a Theory of Instruction (New York: Norton, 1966), in "Cognitive Development and Education," Carmichael's Manual of Child Psychology, Vol. 1, ed. P. Mussen (New York: Wiley, 1970).

[3]Ryland W. Crary, Humanizing the School (New York: Alfred A. Knopf, 1969), p. 15.

Statement of the Problem

Research has indicated some factors which influence achievement are ability, motivation, and health.[1] Limited or overly generalized data however, is available which has indicated how a teacher perceives those factors that affect the learning of the child. These perceptions (perception refers to the popular meaning, "the act, state or faculty of receiving knowledge of external things by the senses"[2]) may affect a student's success; they may also affect a teacher's success in transmitting his/her expectations. Janesick defined perceptions in an educational mode as a

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[1]See Gladys Unruh, Innovation in Secondary Education (New York: Holt, Rinehart, Winston, 1970); Herbert Von Hoden, Innovations in Education (Worthington, OH: C. A. Jones Publishing Co., 1971); Association for Supervision and Curriculum Development, Individualizing Instruction (Washington, D.C.: Association for Supervision and Curriculum Development, 1964); Neal R. Berte, ed., Individualizing Education by Learning Contracts (San Francisco: Jossey Bass, 1965); Lloyd K. Bishop, Individualizing Educational Systems, the Elementary and Secondary School, Implications for Curriculum, Professional Staff and Students (New York: Harper and Row, 1971); C. M. Charles, Individualizing Instruction (St. Louis: Mosby, 1976); Virgil M. Howes, Individualization of Instruction: A Teaching Strategy (New York: Macmillan Co., 1970); Mohan Maden and Ronald E. Hill, Individualized Instruction and Learning (Chicago: Wilson-Hall, 1974); George Ray Musgrave, Individualized Instruction: Teaching Strategies, Focusing on the Learner (Boston: Allyn and Bacon, 1975); Leslie J. Chamberlin, Team Teaching: Organization and Administration (Columbus, OH: C. E. Merrill Publishing Co., 1969); Jean E. Davis, Team Teaching (Washington, D.C.: National Education Association, 1975).

[2]Webster's New American Edition, ed. John G. Allee (New York: Ottenheimer Publishers, 1975).

> reflective, socially-derived interpretation of that which the teacher encounters; this interpretation then serves as a basis for the actions he or she constructs. It is a combination of beliefs and behavior continually modified by social interaction that enables the teacher to make sense of his or her world, interpret it, and act rationally within it.[1]

Therefore, perceptions shall be defined and utilized in both constructs of the educational and formal applications noted above.

The teaching/learning process includes a number of variables such as abilities, needs and interests that affect the success of a teacher in the classroom. As cited in the New York Regents Report of 1938:

> What has become increasingly clear is that school experiences must be planned in terms of life goals of adolescent boys and girls, rather than the traditional academic patterns, and that these goals must be suited to the astonishing diversity that exists in respect to abilities, needs and interests. Some years ago the success of the secondary school might have been estimated from subsequent college careers of its students; today the criterion must be sought in relevance of high school offerings to the needs of the entire population.[2]

The study assessed the perceptions of students and teachers of introductory algebra classes in eight Iowa high

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[1]Valerie Janesick, An Ethnographic Study of a Teacher's Classroom Perspective: Implications for Curriculum (East Lansing, MI: The Institute for Research on Teaching, College of Education, Michigan State University, 1978), p. 3.

[2]Richard M. Kamm, Fredrick M. Raubinger and Merle R. Sumption, Leadership in the Secondary School (Columbus, OH: Merrill Publishing Company, 1974), p. 20.

schools on learning expectations and the effects on achievement.

Rationale

Teachers' and students' perceptions of the learning environment and their expectations may be important to the success of the educational system within the American society in meeting the needs and interests of the students.

The complexities of how people, especially young people, learn has been a persistent concern of educators and their constituents. The necessity in this computer age of ever-changing challenges, occupations and mobility has underscored the need of education to confront the problem of interpretation of learning.

The expectations of society have consistently acknowledged three common aims of education:

1. To develop each student's educational potential to the fullest;
2. To socialize students to become productive members of society;
3. To help channel individuals into different social roles.[1]

The investigation and analysis of the perceptions of the learner and teacher focused on the direction of education

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[1]Arno Luker et al., "Manual of Instruction and Interpretations for the Teaching-Learning Process Analysis Inventory" (Fort Collins, CO: Colorado State College, 1964).

enabling the teacher and student to meet the complexities of the educational environment as it influenced the learners' comprehension of the subject matter, thus their academic achievement and a positive adjustment to their environment.

Algebra was chosen because it is an area in which groups of students with similar years in school, academic training and socio-economic backgrounds could be easily obtained and the cognitive process could be readily measured. Furthermore, teaching of algebra to fifteen-and sixteen-year-olds has been traditional dating back to the 1800's. Although algebra has become somewhat more formal during the modern mathematic movement, it has not changed drastically.[1] Research indicates that many students discontinue their mathematic education with completion of the introductory algebra course. This is supported by Usiskin when he stated, "The standard course (first year algebra) seems to turn off more students than it turns on, giving a view of mathematics as a mechanical process devoted to solution..."[2]

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[1]Zalman Usiskin, "What to Delete from the Algebra-Geometry Curriculum," Mathematics Teacher, 73 (September 1980), 413-24.

[2]Donnald J. Dessart, "Curriculum," Mathematics Education Research: Implications for the 80's, ed. Elizabeth Fennema (Washington, D.C.: Association for Supervision and Curriculum Development, 1980), p. 8.

Purpose of the Study

The purpose of this study was to research the effect of the differences between algebra teachers' and algebra students' perceptions of the teachers' expectations on student achievement. The compiled data and conclusions may be utilized by the involved schools to strengthen the teaching-learning process in their algebra classrooms as it pertains to each participant's individual needs and educational expectations, possibly resulting in educational progress. Staff members may use the data obtained to assess what has been, is and will be expected to transpire in algebra classrooms.

Significance of the Study

The significance of this study is an awareness of the array of perceptions perceived in beginning algebra classrooms by the teacher and the student and how they affect student achievement in algebra. The information, therefore, may be utilized in the high schools involved in preparing curricular learning-teaching style workshops and in-service education programs concerning the teaching-learning process in algebra. It may be also applied to aid and assist algebra students and in communicating with educators, peers, and parents.

This research should provide insights into old and evolving problems, it should improve classroom procedures,

should assist the teacher in being more objective in his/her perceptions, and should assist the teacher to be more thoughtful in the selection of methods used in teaching algebra. The study, therefore, attempted to assess the range and congruence of perceptions between students and teachers in relation to the educational outcomes of the teaching-learning process in beginning algebra.

The data and analysis should be of value in citing areas and concerns for additional research and study. Additionally, it is anticipated that the study will enable the student and the instructor to be involved in curriculum and learning decisions in the algebra classroom, thus enriching their knowledge of the teaching-learning process.

The conclusions of the study should enable the community high school to make informed decisions about teaching-learning changes in the algebra curriculum and classroom which shall be meaningful and enduring to students and staff.

Hypotheses

The following null hypotheses were tested in this study:

I. There is no relationship between perceptual difference scores and algebra grades.

II. There is no difference in the mean perceptual difference scores of male and female students.

III. There are no differences in the perceptions of teachers and students for the forty algebra learning expectations.

IV. There is no difference in the mean algebra achievement score of male and female students.

Assumptions

The following assumptions were made relative to this study:

1. The perceptual differences of teachers and students on student learning could be universally interpreted to exist in most learning environments.
2. There is a similarity of range of perceptions across learning environments.
3. The differences in academic preparation and socio-economic differences will be randomly distributed across the population studied.

Limitations

The results of this study are limited to the eight high schools selected for the investigation. Any generalizations that might be drawn from the results of the study are limited because of the area studied. The investigation may not be representative, though it may be typical, for rural/urban public high schools in Iowa.

This study is further limited in that it does not involve a comprehensive evaluation of the curriculum, or the specific algebra curriculum or textbooks, the time allocation per class in each high school, the teachers, the students, or the community in the eight high schools involved.

Rather, the attempt was to assess the existing learning conditions in the various algebra classrooms by use of an inventory, and one of two math aptitude tests. Additionally, the study was limited to introductory algebra only.

Organization of the Study

Chapter One presents the background of the topic, the problem, the rationale, and significance of the study.

Chapter Two reviews the literature.

Chapter Three describes the design of the study and the methodology to be used.

Chapter Four contains the statistical analysis of the compiled data.

Chapter Five presents a discussion of results of the study and their possible implications for further application and research.

CHAPTER TWO

Research and Literature

Current research and literature referring to perceptions and learning in the confines of education in general and perceptions and learning in mathematics are included in this chapter. Also of concern are three areas of research, learning/teaching styles, hemisphericity[1] and teacher/student perceptions which are interwoven and are concerned with the function of learning and/or the learning environment as it affects the acquisition of knowledge.

Bloom explained that a taxonomy of what is relevant to educational process might lend itself to various classification schemes. For this study the selection for the review included: (1) studies where teacher and student perceptions are compared; (2) studies concerned basically with student perceptions of the learning process; (3) studies concerned basically with teacher perceptions of the learning process; (4) academic achievement in relationship to algebra aptitude; and (5) academic achievement in relationship to perception. This study focused on the perceptions that may require

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[1]Jerre Levy, "Brain Function and Research" (an address presented at IDEA Seminar, Stephens College, Columbia, Missouri, July 14, 1982). (Tape on file at IDEA National Headquarters.)

extensive professional knowledge or skill before teachers can alter instruction successfully to provide for the individual needs of the student.

Within the framework of the above classification scheme, further consideration was given to the following criteria: (1) apparent statistical sophistication, recency and validity of research; (2) extent to which the studies showed equivalency in scope and materials for student, teacher, and community; (3) appropriateness of observational methods which might be related to the teaching-learning process as illustrated in this study.

Current research efforts to explain the underlying processes of learning and teaching reflect two schools of thought. One group is working with "applied" models of learning style. This group, represented by David Hunt, Joseph Hill, and Rita and Kenneth Dunn, is concerned with the multi-dimensional implications of learning style. Interview techniques or self-report questionnaires are utilized to allow students to identify their own perceptions of their characteristic traits. The other school of thought retains a strong preference for the "cognitive" style dimension. A good illustration is the model developed by McKenney and Koen at the Harvard Business School. This model is bi-dimensional rather than simply bi-polar. For McKenney, human information processing has two dimensions: information gathering (perceptive vs. receptive) and information evaluating (systematic

vs. intuitive). Thus far, the model has been applied primarily to the managerial decision making process.[1] The vogue of the 80's is teaching-learning styles in conjunction with research in hemispheres of the brain and the effects of these elements on the acquisition of learning by the student. However, this current interest in learning styles is not a new dimension as it appeared in the research literature as early as 1892. Most of that early research, prior to 1940, concerned the relationship between memory and oral or visual teaching methods.[2] The findings were conflicting, no doubt due in large part to the difference in populations, learning materials, and test instrumentation which were utilized. Most early researchers were preoccupied with finding the one perceptual mode that would best increase learning or retention. Even before 1900, Cattell and Jostrow attempted to relate differences in perceptual mode to general intelligence and learning performance without success.

Research about the brain functions and dusfunctions also appeared in the early 1900's and was researched in relationship to brain damage and transfer of function by Dr. Alfred Strauss at Northville State Hospital in Michigan,

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[1]James L. McKenney and Peter G. W. Koen, "How Managers Minds Work," Harvard Business Review, 53, No. 3 (1974), 79-90.

[2]James W. Keefe, "Learning Style, An Overview," Student Learning Styles, Diagnosing and Prescribing Problems (Virginia: NASSP, 1979), pp. 4-5.

and William Cruickshank in Montgomery County Hospital in Virginia.[1] Most early researchers were concerned with treatment or behavior of dysfunctioning individuals not the specific aptitude of the right and left hemispheres. Levy, Thiez, and Zenhausern, researchers, have conducted extensive research on hemisphericity in "normal" individuals. Rather than dusfunctioning or injured individuals, indications are that the functions of the brain are distinct to each hemisphere though there is overlap and the predominance of being right or left sided can have a definite effect on the individual's perceptions of his/her educational environment.[2]

Cone stated:

> The timing of certain educational experiences is critical in normal brain growth and development,...all human beings have two brain hemispheres and that appropriate and effective education is more likely to occur when instruction takes into account the hemispheric differences and relationships.[3]

Levy continues,

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[1]Janet W. Learner, Learning Disabilities, 3rd ed. (Boston: Houghton Mifflin, 1981), pp. 28-30, 32-33, 40-45.

[2]Levy, "Brain Function and Research."

[3]Henry W. Cone, "Brain Research Finding May Improve Decision Making," NASSP Bulletin, 66 (February 1982), 67-72.

> Normal people do not think with one side of the brain. All attempts at education, whether of reading, writing, mathematics, history, music, art, or whatever, if they are successful, necessarily educate the whole brain. Each side of the brain brings its own special ways of interpreting and understanding the world to all bodies of knowledge, and if this fails to occur, there is a serious pathology and limitation and distortion of understanding. The 19th century class in literature did not educate the left side of the brain any more than it educated the right side. Literature is at least as much an image and configuration as it is a sequential set of syntactically organized words... brain scientists have learned an enormous amount, and many speculations can be derived that only future research can evaluate. But in spite of all this new knowledge, and in spite of all the speculations, there is very little, if anything, that can be translated into educational practice. Educators are desperate for advice. They want to teach and to teach in the best way possible, but the strength of the motivation should not delude them into grabbing hold of any new finding in the brain sciences or any new unverified speculation and converting these into new educational practices. For the time being, at least, teachers will have to rely on their common sense and wisdom and what educational research can tell them. We brain scientist know far too little to design pedagogical systems.[1]

Madeline Hunter expressed succinctly the importance of the use of the knowledge of hemisphere for education and educators at the NASSP conference in January of 1982 when she said,

> We must, with that translation, make available to every teacher, in language (s)he can understand, strategies that effectively and comfortably can be used in his/her classroom regardless of budget, organizational scheme, materials available,

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[1]Jerre Levy, "What Do Brain Scientists Know About Education?" NASSP Newsletter, 3, No. 3 (Autumn 1982), 4, 8.

> pupil-teacher ratio (granted all of those are important, but not determining variables). We must, in turn, present questions and concerns that will focus researchers on areas most productive in terms of learning gain for students. And finally, we must incorporate in our dissemination of important information, our acknowledgment that "We must practice what we preach" and develop left-brained and right-brained input of the information, modeling by our own behavior the fact that neither brain is superior to the other, neither is the chosen one, both are essential to integrated thinking and this world would be a better, more accepting, more stimulating, and more fulfilling place for all of us if we accepted the difference, recognized the similarity, and acknowledged the right to learn of all students.[1]

Dunn, Dunn, Gregory, and Price et al. have researched learning styles in the late 70's and early 80's and concluded that

> learning styles are characteristic cognitive, affective and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment...[2]

Keefe supported this conclusion stating

> learning styles are characteristically cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with and respond to the learning environment.[3]

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[1]Madeline Hunter, "Classroom Strategies Should Reflect Research Findings in Hemisphericity," NASSP Newsletter, 29, No. 8 (April 1982), 10-11.

[2]Rita Dunn, Kenneth Dunn, and Gary E. Price, "Learning as a Matter of Style," The Journal, 6, No. 2 (Fall 1976), 11-12.

[3]Keefe, p. 4.

It seems clear from the research in the domain of education and in the special discipline of mathematics that perceptions of the learner and his/her instructor on the learner's achievement is keyed to communication and understanding by the teacher and the impact of the teacher on that which is learned is dynamic and lasting--positive or negative. Research by Winne, Wienstein and Marx support the notion that the classroom is dynamic and that the exchange of teacher/student relations influence the perceptions, interpretations, and behaviors of both teacher and student.[1] Benyamini has also done research on teacher perceptions of students. Benyamini asked teachers to rate each of their pupils as "a pupil in general" on a seven-point scale. The teachers participating in the study then evaluated their students on the agreed-upon traits. The six traits that were mentioned most frequently were academic achievement, comprehension and ability, interest and curiosity, classroom participation, attention and concentration, and diligence.[2] Piaget and Inhelder noted when studying how children acquire knowledge and learn about the world using

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[1]Philip H. Winne and Ronald L. Marx, "Reconceptualizing Research on Teaching," Journal of Educational Psychology, 69 (1977), 668-78, in Phona Wiestein and Susan Middlestadt, "Student Perceptions of Teacher Intentions with Male High and Low Achievers," Journal of Educational Psychology, 71 (1979), 421-23.

[2]Kalman Benyamini, Teachers' Constructs of the Pupil (Jerusalem: The Hebrew Univ. of Jerusalem, Department of Psychology, 1972), pp. 29-31, 88-112.

number conservation that children number conservation is a hallmark in the development of logical thinking, but most importantly, the studies addressed a fundamental difference between children and adult thinking. Thus Piaget's research indicates that adults and children do not think alike.[1] Hiebert further supported this:

> Children do not think like adults. They view the world from a different perspective; they solve problems by applying qualitatively different forms of thought. A striking example of this is young children's failure on conservation tasks, tasks that seem too "logical" for adults. But the difference in logic does not stop here...suggests that the failure to understand conservation does not interfere with children's performance on mathematical tasks which, from an adult perspective, seem to depend upon this ability. Nonconservers successfully complete tasks for which conservation seems to be a logical prerequisite. It is clear that children think differently than adults.[2]

Fenner went on to say, regarding short-term memory, that,

> Children experience even greater difficulty with these kinds of problems because they have a more restricted capacity. Young children can process only about one-fourth to one-half the number of information pieces that adults can handle.[3]

Case, in his research, indicated that, "The reason for this failure may be children's restricted capacity to deal

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[1]Jean Piaget and Barbel Inhelder, The Child's Conception of Geometry (New York: Basic Book Co., 1960).

[2]James Hiebert, "Children's Thinking," Mathematics Education Research; Implications for the 80's, ed. Fennema, p. 54.

[3]Fennema, pp. 46-47.

with all of the information needed to complete the task.[1]

Hiebert continues this thought:

> It has been more difficult to isolate the effects of this capacity on school mathematics tasks. Recent work in this area suggests that part of the problem in identifying capacity constraints lies in developing valid and reliable measures of processing capacity.[2]

Current research has been exploring process-product aspect of teaching with several conclusions of interest. Good and Grouws studied eighteen fourth grade teachers over a three-year period and concluded after testing the students that the effective teachers consistently provide better instruction resulting in successful mathematical achievement while the converse was true of the less effective teacher.[3] Smith concluded in his research of the process-product format of quantitative research that there were achievement gains by ninth grade algebra students when three interrelated teacher behaviors were present. True global behavior necessary according to Smith, would construct

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[1]Robert H. Case, "Intellectual Development from Birth to Adulthood: A Neo-Piagetian Investigation," Journal of Experimental Child Psychology, 8 (1974), 383-97.

[2]James Hiebert, "Cognitive Development and Learning Linear Measurement," Journal for Research in Mathematics Education, 12 (1981), 197-211.

[3]Thomas Good and Douglas A. Grouws, "Teaching Affects a Process Study in Fourth Grade Mathematic Classrooms," Journal of Teacher Education, 28 (1977), 49-54.

around organization structuring and clarity of lessons.[1]

It seems rather clear once students understand what is expected in the classroom and the material is within a framework of their logic and maturity, one must look at the instruction as it affects the learner in his/her ability to solve problems. Kantowski's and Polya's research indicate that problem solving ability develops slowly over a long period and grows with experience in solving problems. For most students, therefore, systematically planned instruction is an essential factor in development of problem-solving ability.[2] A variety of factors seem to affect the ability of one to be a successful problem solver. In all types of problems with which research has been concerned, the three variables of understanding the problem planning, and computational skill are important.

These three variables constitute the first three phases of Polya's four phases in the solution of a problem. The fourth variable, looking back, is of equal importance but is not as fully researched as the first three variables.[3]

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[1]Lyle R. Smith, "Aspects of Teacher Discourse and Student Achievement in Mathematics," Journal for Research in Mathematics Education, 8 (May 1977), 195-204.

[2]Mary Grace Kantowski, "Processes Involved in Mathematical Problem Solving," Journal for Research in Mathematic Education, 8 (1977), 163-80.

[3]George Polya, How to Solve It, 2nd ed. (New York: Doubleday, 1973).

Studies by Gurova found that students' awareness of their own processes while solving problems had a positive effect in their successes at problem solving.[1] Several studies, elementary and secondary, indicate that students display a variety of problem solving styles. Moser and Kantowski both noted this variable though Kantowski's research also indicated that students did not always select the most efficient solutions but chose those which suited their styles.[2]

Throughout history scholars have dealt with the teaching-learning process in an attempt to discern how "learning" develops. Abelard, St. Thomas Aquinas, Comenius, Rousseau, Pestalozzi and Froebel developed their principles and methods of education on the basis of their experiences and practices. Current social and technological trends in modern societies have brought about a multitude of rapid changes in the nature and functions of schools. The demand

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[1]L. L. Gurova, "School Children's Awareness of Their Own Mental Operations in Solving Arithmetic Problems," in Problem Solving in Arithmetic and Algebra, Soviet Studies in the Psychology of Learning and Teaching Mathematics, eds. J. Kilpatrick and I. Winszup, Vol. 3 (Stanford, CA: School of Mathematics Study Group, 1969).

[2]James M. Moser, Young Children's Representation of Addition and Subtraction Problems. Technical Paper No. 74 (Madison, WI: Wisconsin Research and Development Center for Individualized Schooling, 1979); Mary Grace Kantowski, "Processes Involved in Mathematical Problem Solving," Diss. Univ. of Georgia, 1974.

for mass education and the dissatisfaction with schools have challenged educators to seek ways of adapting education to the needs of all students. If schools are to achieve the major goals of education in modern society, teachers must learn to work in different ways to improve the learning, as did early scholars, of a wide range of students. Parents and students also need to accommodate themselves to the demands, expectations and opportunities that schools can and should provide.

A summary of earlier empirical research into the teaching-learning process concerning teacher behavior is presented by Mallin and Travers:

> Until the 1950's most attempts to discuss and describe patterns of teacher behavior were made in terms of fairly limited sections of teacher behavior. For example, an extensive literature was developed on permissive versus authoritarian behavior in teachers. Other literature exists on the contrasts between teaching according to a recent project method versus a subject matter method. Writers in more recent years have attempted to develop more comprehensive and global forms of classification of teacher behavior.[1]

A researcher who attempted to develop a comprehensive classification of teacher behavior was Richard Anderson[2] in

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[1]Norman E. Mallin and Robert M. N. Travers, "Analysis and Investigation Teaching Methods," Handbook of Research on Teaching, ed. N. L. Gage (Chicago: Rand McNally, 1978), p. 448.

[2]Richard C. Anderson, "Learning in Discussion: A Resume of the Authoritarian-Democratic Studies," Harvard Educational Review, May 1959, pp. 201-15.

his study on the authoritarian-democratic continuum. After he reviewed forty-nine experimental studies using the authoritiarian continuum, Anderson concluded that this dimension is an inadequate basis for research. He suggested that group life is too complex to be described in a single dimension. Another difficulty concerning this continuum is the lack of adequate models of how the authoritarian-democratic continuum is related to learning. The authoritarian-democratic continuum therefore provides an inadequate conceptualization which does not make it useful in studies of the teaching-learning process.

Literature of the past decade reflects the emergence of a new theory, which suggests that individual students acquire, perceive and/or retain knowledge, skills, direction, or attitudes in a variety of ways dependent upon their own unique responses to their individual environment, emotionality, sociological and physical preferences, and how their minds process information. In other studies, a more complex picture emerges. Solomon and Kendall state that rating scales which focus on nonintellectual characteristics result in greater discrimination by teachers between different student attributes. They conclude, "Teachers' perceptions of students' academic ability and performance are primary

and influence perceptions of all other attributes."[1] Lambert and Nicoll cite several teacher perception studies in which rating scales were used that provide support for a three-dimensional model of student affect. This model distinguishes among student characteristics relating to classroom adaptation, interpersonal adjustment and intra-personal adjustment. Lambert and Nicoll's model suggests that teachers are concerned both with students' adaptational status and their adjustment characteristics.[2] Brown et al. conclude, "Individuals can be taught strategies that process information more efficiently and push back the limits that might otherwise be imposed by their restricted processing capacity."[3] Although this theory represents a relatively new focus, it has been alluded to in studies for the last century. Other studies have suggested that each student does learn and perceive in a pattern that varies, often drastically, from others. Dunn and Dunn state that:

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[1]Daniel Solomon and Arthur J. Kendall, "Dimensions of Children's Classroom Behavior, as Perceived by Teachers," American Educational Research Journal, 10 (1977), 411-21.

[2]Nadine M. Lambert and Richard C. Nicoll, "Conceptual Model for Nonintellectual Behavior and Its Relationship to Early Reading Achievement," Journal of Educational Psychology, 3 (1977), 481-90.

[3]Ann L. Brown, Joseph C. Champione, and Jeanne T. Day, "Learning to Learn: On Training Students to Learn from Texts," Education Researcher, 10 (1981), 14-21.

> music, laughter, and other loud noise may be the key to improved academic achievement for some students while others learn best in a hushed environment. Teaching approach must be identified and matched to each student's learning style. When students' learning style matches the teacher the teacher's style, student attitudes and motivation improve. The styles involve four different basic ways of learning: auditory, tactual, kinesthetic, and visual,...The younger the student, the more structure he or she needs. In other words, we are doing everything backwards. We give less structure and more choice to kindergarteners and lots more structure and less choice to secondary students.[1]

The Dunn's stressed findings that provide other insights to educators: "Subject matter should be introduced through the strongest perceptual strength of the student, and then reinforced through the second strongest perceptual strength."[2] The research findings of Dunn and Dunn, Levin and Long, and McKenzie have drawn out the significance of student perceptions as it effects educational learning. Therefore, students' perceptions may have a direct conditional effect on their learning.

McKenzie focuses his attention on four principles that a teacher can use to influence what goes on in a student's mind:

1. Establishing sets,
2. Eliminating irrelevant data,

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[1]Rita Dunn and Kenneth Dunn, "Learning Styles," NASSP Newsletter, 29 (April 1982), 4-5.

[2]Dunn and Dunn, "Learning Styles," pp. 4-5.

3. Organizing data with cues,
4. Eliciting frequent responses from all individuals.[1]

Additionally, he stated,

> The teacher who cares about pupil success must learn to anticipate difficulties and elicit, focus, and sustain appropriate attention and processing behaviors in students, no matter what form of media is used or whether the lesson is expository or inquiry-oriented.[2]

Levin and Long reinforced this promise in their research and review of efforts by Bushness et al. (1968), Chadwick and Day (1971), Hops and Cobs (1972, when they referred to student academic success when they are involved and understood the process. The authors stated further that:

> All the studies share one underlying principle. If instructional processes and procedures elicit student behavior relevant to the learning task, student involvement is likely to increase. In contrast, if the instructional conditions shift student attention from the main foci of the learning task, or if the instruction is misleading or disturbing, then active learning time is likely to decrease to a substantial degree. Thus, instructional conditions as well as explanations and directions for learning have the potential to alter student involvement in learning.[3]

Reisman adheres to this concept when he declared, "Children may not be learning because the methods of

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[1]Gary R. McKenzie, "Helping Students Learn What Teachers Mean to Teach," The Social Studies, 71 (November/December 1980), 270-74.

[2]McKenzie, pp. 270-74.

[3]Tamra Levin and Ruth Long, Effective Instruction (Virginia: ASCD, 1981), p. 6.

learning are not suited to their style and hence they cannot best use their mental power."[1] Marcus said, "...it is virtually impossible for even the most conscientious and knowledgeable teacher to know exactly the learning style of each of his students by observation alone."[2] He recommended that a more reliable determinant, such as a learning style questionnaire or inventory is necessary if errors in teachers' perceptions are to be avoided so as to prevent miscalculations and ineffective instruction for students involved in the learning process. Willis had teachers rank students on their expected achievement. He found that variables known to be related to student achievement, such as attentiveness, self-confidence, ability to do assigned tasks, and maturity, were closely associated with teachers' achievement expectation rankings.[3] A limited study conducted by Hudes, Saladino and Meibach to determine whether any relationship exists between a student's learning style and self-concept revealed that individuals with high self-concept tend to respond to different

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[1]Frank Reisman, "Students' Learning Styles: How to Determine, Strengthen, and Capitalize on Them," Today's Education, 65, No. 3 (September/October 1976), 98-99.

[2]Marcus Lee, "How Teachers View Student Learning Styles," NASSP Bulletin, 61, No. 408 (April 1977), 113.

[3]Sherry L. Willis,"Formation of Teachers' Expectations of Students' Academic Performance," Diss. Univ. of Texas at Austin, 1973, pp. 89-96.

learning stimuli than those with a comparatively lower self-concept.[1] Rosenthal and Jacobson's research indicates that teacher expectations regarding student ability were related to actual student performance, low expectations result in low performance and high expectations in high performance, thus creating a self-fulfilling prophecy.[2]

In his study of human characteristics and their relationships to school learning, Bloom verifies that students must be taught through varied strategies if they are to achieve to their maximum potential. He proposed a significant model of school learning, which he identified as mastery learning. His theory applied three elements: student characteristics, instruction, and learning outcomes. His thesis is that there are three interdependent variables that account for the greatest degree of variance in student learning. These variables are:

1. Cognitive entry behaviors--the extent to which the student has already learned the basic prerequisites to the learning to be accomplished;

2. Affective entry characteristics--the extent to which the student is or can be motivated to engage in the learning process;

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[1]Sonia Hudes, Antionette Saladino and Donna Meibach, "Learning Style Sub-scales and Self-concept Among High Achievement Third Graders," The Journal, 7, No. 2 (Fall 1977), 7-10.

[2]Robert Rosenthal and Lanore Jacobson, Pygmalion in the Classroom: Teacher Expectation and Pupils Intellectual Development (New York: Holt, Rinehart, Winston, 1968), pp. 78-112.

3. Quality of instruction--the extent to which the instruction to be given is appropriate to the learner.[1]

Fischer and Fischer, in their study, stressed the individualization of learning style and also the overlap between types saying that all styles are not by characteristic exclusive to each other.

> Human beings do not come in pure types to fit intellectual constructs...we make the assumption that most human beings can be changed, and therefore, to some extent at least, both learning and teaching styles can be modified. It is our further belief that, as professionals, teachers must be willing to examine and to alter their teaching styles if evidence or the judgment of other professionals warrant such change. Such change must always be guided by the key consideration: Will this change help or hinder the learner in developing toward autonomy.[2]

Other research studies continue to support the existence of individual learning differences. Tallmadge and Sherrer conducted several investigations which supported the existence of unique learning style characteristics. Measures of aptitude, interest and personality were used to identify subject's learning styles.[3] Reinert

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[1]Benjamin S. Bloom, Human Characteristics and School Learning (New York: McGraw-Hill Book Co., 1976).

[2]Barbara Bree Fischer and Louis Fischer, "Styles in Learning and Teaching," Educational Leadership, 36, No. 4 (January 1979), 245-51, 254.

[3]G. Kasten Tallmadge and James W. Sherrer, "Relationships Among Learning Styles, Instructional Methods, and the Nature of Learning Experiences," Journal of Educational Psychology, 60, No. 3 (March 1969), 222-30.

explored "Learning Styles" in terms of student perceptual strengths.[1] Raywid examined the same phenomena in terms of models of the actual teaching-learning situation.[2] Marcus verified the need for teachers to recognize differences between the learning styles of males and females and to accommodate individual differences.[3]

Explorations into the area of learning style have also been conducted by Dunn and Dunn, and Dunn, Dunn and Price.[4]

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[1]Harry Reinert, "One Picture is Worth a Thousand Words Not Necessarily!" The Modern Language Journal, 4 (April 1976), 160-68.

[2]Maryanne Raywid, "Models of the Teaching-Learning Situation," Phi Delta Kappan, 58, No. 8 (April 1977), 631-35.

[3]Marcus Lee, "A Comparison of Selected Ninth Grade Male and Female Students' Learning Styles," The Journal, 6, No. 3 (January 1977), 27-28.

[4]Rita Dunn and Kenneth Dunn, "A Positive Paper for Further Individualization of Instruction in the Schools," Audiovisual Instruction, 17, No. 9 (November 1972), 49-55; Rita Dunn and Kenneth Dunn, "Learning Style as a Criterion for Placement in Alternative Programs," Phi Delta Kappan, 56, No. 4 (December 1974), 275-79; Rita Dunn and Kenneth Dunn, "A Regional Approach to Individualization: Rationale and Performance Criteria," The Journal, 4, No. 4 (January 1975), 37-41; Rita Dunn and Kenneth Dunn, Educator's Self-teaching Guide to Individualizing Instructional Programs (West Nyack, NY: Parker Publishing Co., 1975), Chapters 3 and 4; Rita Dunn and Kenneth Dunn, "Finding the Best Fit: Learning Styles, Teaching Styles," NASSP Bulletin, 59, No. 393 (October 1975), 37-49; Rita Dunn and Kenneth Dunn, Administrator's Guide to New Programs for Faculty Management and Evaluation (West Nyack, NY: Parker Publishing Co., 1977), Chapters 3, 4, 5, 6; Rita Dunn and Kenneth Dunn, "Be a Better Teacher: How to Diagnose Learning Styles," Instructor, 87, No. 2 (September 1977), 122-44; Rita Dunn and Kenneth Dunn, "Educational Accountability in Our Schools," Momentum, 19, No. 3 (October 1977), 10-16; Dunn, Dunn, and Price, pp. 11-21;

Their findings have indicated that when learning styles of individual students are identified and complemented by appropriate educational strategies, gains in academic achievement results. Rosenthal and Jacobson support Dunn, Dunn, and Price in like research. Levin and Long spoke clearly on the concept of individuality and learning when they stated:

> A major implication of our approach to learning and instruction is concerned with the concept of educational practices and the question of individual differences. There is a prevailing view among many educators that not all students can learn what schools and teachers desire to teach or achieve. Consequently, individual differences provide a ready-made excuse, and the blame for students' inability to learn is placed on the students' genetic or environmental background. Only rarely do we hear teachers explaining students' inability to learn as a result of the way they were taught.[1]

Public Law 94-142, the Education for All Handicapped Children Act, was enacted as a result of this apathy and a human need. The law underscored the importance of an individual's learning by mandating the diagnosis of educational needs for all exceptional students. When students are identified as physically impaired, emotionally disturbed, learning disabled, or "gifted," an Individualized

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Rita Dunn and Kenneth Dunn, "Diagnosing Learning Styles: A Prescription for Avoiding Malpractice Suits," Phi Delta Kappan, 58, No. 5 (January 1977), 418-20.

[1]Levin and Long, p. 56; Mary M. Rohrkomper and Jere Brophy, "Teachers' Thinking About Problem Students," in Teacher-Student Perceptions: Implications for Learning, eds. J. Levine and M. Wang (Morristown, NJ: Earlbaum, 1982).

Educational Plan (IEP) incorporating appropriate educational curricula and treatment must be developed as perceived by the parent, student, teacher(s), and administrator. Failure to identify appropriate educational needs and to develop complementary individualized prescriptions for handicapped students may result in additional judicial and legislative demands for accountability.[1]

Thus, research of social and legal pressures indicate a need to understand the perceptions of the learner and teacher in the algebra classroom to assist the algebra student to achieve his/her potential.

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[1]Rita Dunn and Robert Cole, "Inviting Malpractice through Mainstreaming," Educational Leadership, 36, No. 5 (February 1979), 302-06; Phil C. Robinson and Gail Von Huene, "Meeting Student Special Needs," Helping Teachers Manage Classrooms (Virginia: ASCD, 1982), p. 70.

CHAPTER THREE

Methodology

The major purpose of this dissertation was to utilize a teaching-learning-process analysis inventory. This inventory, composed of two parts, measured the relative emphasis placed on the various significant aspects of the teaching-learning process in algebra with the data correlated to the demographic information to ascertain recommendations and test the hypotheses.

The inventory consists of two parts entitled, Teaching-Learning Process Analysis Inventory Teacher Form A (Appendix A), and Teaching-Learning Process Analysis Inventory Student Form AA[1] (Appendix B), with an attached demographic instrument for students and teachers. The Iowa Algebra Aptitude Test (Appendix C) or Iowa Test of Educational Development (quantitative thinking segment) (Appendix D) were administered to similar groups of algebra students in eight Iowa high schools. The need to utilize two instruments was necessary because six high schools used the Iowa Algebra Aptitude Test and two schools used the

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[1]Luker et al., n.p.

Iowa Test of Educational Development. The Student Form AA and the Iowa Algebra Aptitude Test was administered to 42 to 122 students in each school for a total of 636 students.

The Teacher Form A was administered from one to three algebra teachers in each school because not all schools had the same number of teachers teaching algebra, with a total number of fifteen participating algebra teachers from eight similar Iowa high schools.

The eight Iowa high schools that participated in the study were: Algona High School, Clarion High School, Clear Lake High School, Eagle Grove High School, Hampton High School, Humboldt High School, Iowa Falls High School, and Webster City High School.

These schools were chosen because of their similarities in student and teacher populations. Each high school is located in a rural/urban setting in north central Iowa with its economic base composed of agriculture and agriculturally related industries. The communities are predominantly Caucasion with minimal numbers of minorities. Another reason these schools were chosen was because of the need to have suitable numbers of teachers to insure a valid study. The student body of one or two of the high schools would have provided adequate numbers of students but a less than suitable number of teacher samples would have been available to gather reliable data to insure a valid study.

The procedure to gather data was as follows: each

selected school's counselor(s) compiled the scores of students obtained from the Iowa Algebra Aptitude Test or the quantitative thinking segment of the Iowa Test of Educational Development for each introductory algebra student in September of 1981. Each student was assigned a number which was arranged in numerical order according to last name. The student's identity was protected in that it was known only to the high school counselor who listed only the student's identification number which was placed on his/her inventory form and submitted for analysis. An example of this would be 52213. The first digit would identify the school (5-Hampton). The second digit would indicate the teacher (2-teacher two). The next digit would indicate the class (2-class two). The next two digits would indicate the student (13-student thirteen). The student number and teacher number were correlated, an example would be 52000, with the same value given as to sequence, though the latter three zeros are dummy numbers for computer use (Appendix E).

Teachers were given numbers indicating school, sex, and which group of students were their introductory algebra students. The teacher's identity was protected in that they were known only by their identification number.

In January of 1982, one week before the end of the first semester, the teacher and students were given inventories, Student Form AA of the Teaching-Learning Process Analysis Inventory and Teacher Form A of the Teaching-Learning

Process Analysis Inventory.

The process was explained to each counselor and building principal in written form (Appendix F) prior to distributing the inventories to teachers and students. The building principals were also given an explanation and overview verbally prior to the written communication. The teachers and students were provided succinct instruction for completing forms A and AA of the inventory (Appendix G). The counselors in each selected high school answered the teachers' questions about the survey and teachers answered the students' questions prior to beginning the inventory. However, the teacher did not answer inquiries about the questions within the body of the student inventory Form AA during administration of the inventory.

The high school counselors were given a tally sheet (Appendix H) listing students by number, sex, their percentile scores on the Iowa Algebra Aptitude Test and Iowa Test of Educational Development (quantitative thinking) and their academic grade in introductory algebra for the first semester. Academic grades were given in letter form and then transposed to a numerical standard to expedite computer format and analysis. The system employed was as follows:

A	= 4.00	C-	= 1.75
A-	= 3.75	D+	= 1.50
B+	= 3.50	D	= 1.00
B	= 3.00	D-	= 0.75
B-	= 2.75	F	= 0.00
C+	= 2.50		
C	= 2.00		

This procedure was utilized, to facilitate computer format entry and analysis and because the reporting high school counselors indicated grades as scaled above and each district computed grade point averages on a 4.00 scale, four (4) for an A to zero (0) for an F.

The Iowa Algebra Aptitude Test and the Iowa Test of Educational Development (quantitative section) were selected as pre-entry indications of students' potential successes in algebra because the raw scores could easily be translated to percentile, thus providing a common base of standards for analysis, each of the assessment tests had a detailed history of application and validation (norms) throughout Iowa and the United States.

Each high school in the study administered one or the other of the aptitude tests to incoming algebra students, thus assuring that each student sample was of similar ability range. Thus, each student had to score at a given level, as determined by each school, on one of the mathematics assessment instruments. Additionally, by using validated instruments, the researcher was released from the obligation of measuring, through testing, algebra aptitude prior to administering the inventories.

The counselors collected the teachers Form A of the inventory with the number affixed indicating school, sex, and classroom designation. The counselors also provided a list of students by number with the correlated algebra

assessment score and then procured from the algebra teacher the actual semester grade of each student.

Students who missed the inventory or failed to answer all forty questions were deleted from the study with all data purged from the results. Each algebra teacher was present and answered all questions; therefore, it was not necessary to provide any dispensation for the classroom teachers.

Algebra teachers were not administered any pretest as each teacher was certified by the State of Iowa to teach in his/her area of professional competency, mathematics, particularly algebra. Therefore, there was not a need for further validation as to the qualifications of the teacher.

The demographic data from the student and teacher surveys were entered on the Drake University Dial Center computer for statistical processing applying the number sequence for each respondent. The number system which afforded the most applicable transfer of data and analysis was as follows: Identification number 52314; the identification value would be five (5) to indicate the school, two (2) would indicate which algebra teacher, for the teacher this could be from (1) to (3). Three (3) would indicate which algebra class, and fourteen (14) would indicate which algebra student, for the student this could be from one (1) to twenty-seven (27).

Selection of the Sample in Each School

Student samples included 636 introductory algebra students from eight selected Iowa high schools. The students completed Student Form AA of the Teaching-Learning Process Analysis Inventory. The Student Form AA was administered internally within the high school to classes of algebra students. Also, each student was given the Iowa Algebra Aptitude Test or the Iowa Test of Educational Development (quantitative section) as an indicator of algebra aptitude. The Teacher Form A was self-administered. The directions for administration of the Student Form AA were given prior to distributing the inventory to the students. The sample students and teachers were selected as a result of their correlation of age, year in school, community, school size and curriculum offering.

The Instruments

The two forms of the instrument which were administered to algebra teachers and algebra students in the eight high schools are the Teaching-Learning Process Analysis Inventory, Teacher Form A and Student Form AA.

The inventory was designed to measure the amount of time spent in various activities in the classroom. The two instruments are parallel: each question in the teacher form was designed to measure the same areas as the comparable questions in the student form. The difference between the two instruments was that the questions in the teacher form

are worded to suit teacher groups while questions in the student form are worded to suit student groups. The demographic instruments were administered to high school algebra students. Each algebra student had taken the Iowa Algebra Aptitude Test or the Iowa Test of Educational Development (quantitative thinking section) as an indicator of aptitude in algebra to insure a similarity of entry level abilities, thus providing homogeneity of the sample populations.

The Teaching-Learning Process Analysis Inventory, Teacher Form A and Student Form AA, were developed by Dr. Eugene Koplits, Dr. Arno Luker, Dr. Charles McLain, and Dr. Jack Shaw. The inventory was developed in connection with the Bureau of Research Service, Colorado State College, Greeley, Colorado, in an attempt to refine techniques describing and evaluating the teaching-learning process.

The authors reviewed previous research findings to identify important phases of the teaching-learning process. The instruments were originally designed with seventy-one questions covering clusters of eight aspects of the teaching-learning process. With these eight categories, inventory items for both teachers and students forms were clustered. The categories chosen were as follows: (1) motivation, (2) individual differences, (3) transfer of learning, (4) focalization, (5) levels of learning, (6) differentiation in application, (7) the classroom environment (setting), and (8) evaluation. Items relating to each

of the eight categories were included in both Student Form AA and Teacher Form A. In 1965, the instrument was used in a study of Colorado schools done by DeBoer and Spracklin, and again in 1967 by Jensen in a study of thirteen schools in North Dakota.

Time was decided upon as the medium of measurement. A sample item might read like this:

> In this class we have total class discussion or activities: (1) 0% to 5% of the time; (2) 5% to 33% of the time; (3) 33% to 66% of the time; (4) 66% to 95% of the time; (5) 95% to 100% of the time.

The authors pointed out several advantages to this type of measurement: (1) students and teachers could readily pass judgment on the amount of time spent on various activities thus obviating judgment of the teacher on class efficiency; (2) upper and lower limits of the scale were specifically established respectively to 0 to 100 percent; (3) the range from 0 to 100 percent of the time spent in a particular class activity were subdivided in quantified units having equal size and which would have the same meaning for teachers and students; and (4) "time" as a measurement appeared to best meet all the requirements of principles established.[1]

A forty-item inventory was used in this study. Time remained the medium of measurement with five selections of

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[1] Luker et al., n.p.

time possible. The data were treated as correlated relationships partialing out sex differences and algebra aptitude.

Analysis of the Data

Teacher-Student

The completed instruments were prepared for statistical processing at Drake University's Dial Computer Center. The Standard Statistical Package for Social Sciences was utilized in the processing of the data. Means to determine the tendency were calculated for each of the forty perception questions on the correlated teacher and student inventories and the Hotelling's T^2 test, a multivaria analysis and the Pearson Product-Moment Correlation was also conducted.

The results of the Hotelling's T^2 test procedures were transformed in an F value. The F value was calculated to determine if a significant interaction was present. The calculated F value was compared against a .05 critical value of the tabled F ratio. An F value that exceeded the tabled critical value indicated significant differences existed between sample means and the null hypothesis was rejected. An F value less than the tabled critical value indicated that no significant differences existed between the sample means and the null hypothesis was retained.

An additional analysis procedure was conducted using the Pearson Produce-Moment Correlation. This correlation

is a parametric technique employing continuous data. The .05 level of significance was again utilized to determine whether significant differences existed between the sample means. Accumulated value for each survey question was obtained and compared against the critical value of .05. A calculated value that exceed the critical value at the .05 level indicated significant differences existed between the sample means and the null hypothesis was rejected. A calculated value less than the tabled critical value indicated that no significant differences existed between the sample means and the null hypothesis was retained.

The null hypotheses to be tested applying the above statistical methods are:

1. There is no relationship between perceptual difference scores and algebra grades.
2. There is no difference in the mean perceptual difference scores of male and female students.
3. There are no differences in the perceptions of teachers and students for the forty algebra learning expectations.
4. There is no difference in the mean algebra achievement score of male and female students.

Statistical Treatment

The multivariate analysis used in this study was the appropriate statistical tool. It would have been inappropriate to use a separate univariate analysis such as independent test for each of the dependent variables in this study for two reasons. First, the application of

univariate tests--one for each dependent variable--would have caused the probability of a Type I error to be higher than the level of significance that was used. This means that the univariate test is positively biased and the null hypothesis will be rejected too often. The second reason is that as the number of dependent variables, in this study more than eighty, increases the probability of finding a significant difference by chance alone increases.[1] Two follow-up procedures are recommended: simultaneous confidence intervals and two group linear discriminate function. The latter of these two procedures was used for the same reasons previously mentioned and because it was the appropriate follow-up test.[2]

The multivariate Hotelling's T^2 test is predicated on the double assumption that the sample data have been drawn from multivariate normal populations and these populations have equal dispersion matrices.[3]

The second statistical treatment utilized in this study was the Pearson Product-Moment Correlation. This was the appropriate statistical tool to utilize for hypothesis one due to the fact that correlations measure central tendency and relationships between two variables.[4] There

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[1]Schuylor Huck, William Cormier, and William Bound, Readings in Statistics and Research (New York: Harper & Row, 1974), pp. 178-79.

[2]Ibid., pp. 180-81. [3]Ibid., pp. 30-31.

[4]Ibid., pp. 30-31.

are two common correlations. The Spearman's Rho measuring nonparametric technique and the Pearson Product-Moment Correlation which utilizes a parametric technique and measures continuous data.[1] Thus the Pearson Product-Moment Correlation is the most appropriate tool.

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[1] Ibid., pp. 30-31.

CHAPTER FOUR

Analysis of Data

In this chapter, a statistical treatment of the teaching-learning processes is presented analyzing the inventories of algebra teachers and their students to indicate to what degree, if any, the hypotheses are found to be supported within recognized limitations. The statistical data level of significance was tested and accepted at the .05 level; however, as will be evidenced on several tables, the level of significance was at a more stringent .01 level.

The study was designed to determine whether differences existed between the perceptions of algebra teachers and introductory algebra students of learning expectations and the effects on achievement.

Presentation of Data

The inventories were distributed to eight Iowa high schools of similar student and staff populations. The data were tabulated in Table 1 from the demographic information on the tally sheet submitted by the high school counselors. The returned inventories were grouped by school, and subgroups by teacher and students. The data were tabulated

in each of these categories. The result of this grouping is reported in Tables 1 and 5.

Participating schools were listed alphabetically (Table 1) and average class size was determined by dividing the number of class(es) of each teacher into the number of students to show the similarity of the samples.

Table 1

Eight Iowa High Schools and the Numbers of Students and Teachers with the Average Class Size

School	Student	Teachers	No. of Classes	Average Class Size
Algona	104	2	3	24.6
Clarion	45	2	3	15.0
Clear Lake	113	3	5	22.6
Eagle Grove	62	1	2	31.0
Hampton	58	1	3	19.3
Humboldt	41	1	2	20.5
Iowa Falls	104	2	6	17.3
Webster City	109	3	6	18.3
Totals	636	15	30	21.2

The sex of the fifteen algebra teachers in the eight high schools are: males thirteen, females two. Clear Lake and Clarion each have one female teacher.

The students, male and female, were grouped in Table 2 by sex to show the student composition in the eight sample high schools. The table divulges that the composition of the schools is similar and that 75 percent, six of eight, have more females than males.

Table 2

Number of Male and Female Students in Introductory Algebra Classes

School	No. Male Students	No. Female Students	Total No. Students
Algona	48	56	104
Clarion	22	23	45
Clear Lake	49	64	113
Eagle Grove	25	37	62
Hampton	27	31	58
Humboldt	22	19	41
Iowa Falls	40	64	104
Webster City	67	42	109
Total	300	336	636

In Table 3, all of the teachers responded and returned the inventories, and 636 students responded and returned the inventories. The table was further divided to discern the returns by sex of the students. Table 3 indicates, when compared to Table 2, that all but nine students returned an inventory.

Table 4 shows the response of teachers and students to the forty questions on the inventory. The table shows that all fifteen teachers responded to the forty questions, therefore, there was little cause to develop a table. However, Table 4 indicates that the student results were not a totality. When comparing Table 3 to Table 4 there is a difference in response by students to all forty questions on the inventories and the number returned. Six hundred twenty-seven students returned inventories with 588

Table 3

Eight High Schools and the Number of Inventories Returned by Male and Female Students and the Algebra Teacher

School	Teacher Total	Male Students	Female Students	Student Total
Algona	2	45	56	104
Clarion	2	22	22	44
Clear Lake	3	48	62	110
Eagle Grove	1	25	37	62
Hampton	1	27	31	58
Humboldt	1	22	19	41
Iowa Falls	2	40	62	102
Webster City	3	67	41	108
Total	15	297	330	627

Table 4

Eight High Schools and the Number of Male and Female Students Responding to all Forty Questions on the Inventory

School	Male Students	Female Students	Total
Algona	45	53	98
Clarion	19	20	39
Clear Lake	46	61	107
Eagle Grove	21	35	56
Hampton	23	29	52
Humboldt	19	16	35
Iowa Falls	37	61	98
Webster City	64	39	103
Total	274	314	588

answering all questions. Males and females also responded to answering all the questions at a different rate when compared to Table 3 than the number of returned inventories. Two hundred seventy-four of 297 males and 314 of 350 females returned inventories with a response to all forty questions. This would show a higher rate of completed inventories by females than males.

The demographic material was tabulated in Table 5 to illustrate the difference in the number of inventories actually distributed and the actual validated inventories utilized as data in this study. The fifteen teacher inventories were used in total as each teacher responded to all questions on the inventory. As shown in Table 5, the percentage of return of the total sample was 92.5 with the lowest percentage of valid inventories returned by the individual school being 85.3.

The returned inventories were grouped and data were tabulated in each of four categories: algebra teachers, algebra students, sex of the algebra students and grade point average of the algebra students.

Tables 6 through 8 present the test results of Hypothesis One: There is no relationship between perceptual difference scores and algebra grades.

The summary tables utilized in reporting the results of the Pearson Product-Moment Correlation have three columns: Inventory Questions, R value or index of relationship

between the Grade Point Average (GPA) and student perceptions of the teachers' expectations and Significance. The table would indicate that a negative (-) R value is indicative of a high grade point average and low perceptions of the teachers' expectation when a positive (+) R value would be indicative of a high GPA average and high perceptions of the teachers' expectations.

Tables 6 and 7 separate the R-value inventory questions which show a positive R value and the inventory questions which are not significant at the .05 level and are denoted with an asterisk (*).

Table 5

Eight High Schools with the Number of Male and Female Students Available to Take the Inventory and the Number who Responded and the Number who had Valid Inventories

School	Available Students Male	Female	Total	Total Student Valid Inventories	Percent Differences
Algona	48	56	104	98	5.8
Clarion	22	23	45	39	13.4
Clear Lake	47	64	113	107	3.4
Eagle Grove	23	37	62	56	9.7
Hampton	27	31	58	52	10.4
Humboldt	22	19	41	35	14.7
Iowa Falls	40	64	104	98	5.8
Webster City	67	42	109	103	5.6
Total	629	336	636	588	7.5

Table 6

Correlation Between Students' Perceptions of Teacher Expectations and Algebra Grades

Inventory Questions	R-Value	Significance
IN THIS CLASS...		
1. ...I would prefer to have the teacher do all the planning of assignments and class activities...	-.1448	.000
2. ...I would prefer to work with the teacher in planning my own individual assignments and class activities...	-.0732	.059*
3. ...I would prefer having the whole class work with the teacher in planning assignments and class activities...	.0172	.678*
4. ...I feel the whole class should work with the teacher in planning assignments and class activities...	.0106	.798*
5. ...I work the way I do in the class because I feel I am helping myself...	-.1144	.006
6. ...we are listening to the teacher or watching the teacher demonstrate...	-.0427	.302
7. ...the work is too difficult rather than about right for me and the students of my age group and grade...	.0270	.515
8. ...my work suffers because I lack necessary experience and background...	-.0031	.941
9. ...I am really interested in getting started and working on class activities...	-.0297	.413
10. ...I feel that the teacher is interested in getting started and working on class activities...	-.0606	.143
11. ...I dislike starting the class and I look forward to its end...	-.1052	.011*

Table 6 (continued)

Inventory Questions	R-Value	Significance
12. ...I feel that the teacher dislikes starting the class and looks forward to its end...	-.0119	.774
13. ...individual assignments and activities are provided for various members of the class to allow for differences in interests, backgrounds, and experience...	-.0089	.830
14. ...I feel my assignments and class activities are of practical-useful value to me...	-.0667	.107
15. ...the teacher tries to give us practice in looking for places where we might use outside the classroom what we have learned...	-.0150	.717
16. ...the teacher tries to give us practice in understanding how we might wrongly use outside the classroom what we have learned...	-.0134	.747
17. ...I would prefer to work alone during the class period without consulting or talking with the teacher...	-.0041	.921
18. ...I would prefer to work alone but with the right to consult or talk with the teacher...	.0040	.924
19. ...I would prefer to work alone but with the right to consult or talk with my classmates when I wish...	.0110	.790
20. ...I would prefer to work cooperatively with small groups of classmates...	-.0253	.541
21. ...I am satisfied with the class activities and assignments...	-.1470	.000*
22. ...other class members and I are permitted to explore and to talk freely about our feelings about this class...	.0496	.231

Table 6 (continued)

Inventory Questions	R-Value	Significance
23. ...my classmates and I discuss our feelings about this class...	-.0146	.724
24. ...my classmates and I discuss in class our feelings about ourselves and our feelings about each other...	-.0840	.042*
25. ...my classmates and I discuss in class ways of getting along with each other and ways of feeling more pleasant about ourselves and others...	-.0628	.129
26. ...we listen to the teacher lecture or give demonstrations without a chance to discuss or ask questions...	-.1803	.000*
27. ...we are permitted to discuss or ask questions while we are listening to the teacher lecture or give demonstrations...	-.1746	.000*
28. ...we have to memorize facts or other material...	-.0101	.807
29. ...the teacher is available to give me help when I desire help...	-.0322	.437
30. ...the teacher helps me think through and work out my own difficulty or problems when I ask the teacher for help...	-.0838	.043
31. ...my classmates and I feel relaxed and happy as we go about doing our class work.	-.2081	.000*
32. ...we talk about our problems and get rid of our unpleasant feelings...	-.1150	.005*
33. ...we talk about how we feel about what we learn...	-.1274	.002*
34. ...we talk about how our ideas are changing...	-.0184	.658
35. ...we talk about how these changes will affect us in later life...	.0365	.378

Table 6 (continued)

Inventory Questions		R-Value	Significance
36.	...we take tests to decide what grade we will get in class...	-.0380	.358
37.	...I am happy to get back a test I have taken...	-.2410	.000*
38.	...the teacher works with us to discover the error we have made during tests...	-.0275	.507
39.	...the teacher works with us to help us understand what we did wrong and why we made errors during tests...	-.0649	.117
40.	...I would prefer to take tests...	-.0225	.587

Table 7

Inventory Questions Which Show a Positive Relationship Between Student Perceptions of Teachers' Expectations and Algebra Grades

Inventory Questions	R-Value	Significance
1. ...I would prefer having the whole class work with the teacher in planning activities and class activities...	.0172	.678
2. ...I feel the whole class should work with the teacher in planning assignments and class activities...	.0106	.798
3. ...I would prefer to work alone but with the right to consult or talk with the teacher...	.0040	.924
4. ...I would prefer to work alone but with the right to consult or talk with my classmates when I wish...	.0110	.790
5. ...other class members and I are permitted to explore and to talk freely about our feelings about this class...	.0496	.231
6. ...we talk about how these changes will affect us later in life...	.0365	.378

Replies received from seven of the forty inventory questions indicated that students with high algebra grades have high perceptions of teacher expectations. However, it should be noted that none of the questions were significant at the .05 level. Thus, the null hypothesis: There is no relationship between perceptual difference scores and algebra grades, cannot be rejected as it relates to the seven positive correlations.

Table 8 indicates that the negative R-Value, the relationship between teacher expectations and GPA, response of students would show that students who received high grades did not perceive the expectations of the teacher. Table 8 is significant at the .05 level; therefore, Null Hypothesis One is rejected. It should be noted that twelve of the forty questions, 30 percent, were significant.

Hypothesis Two stating there is no difference in the mean perceptual difference scores of male and female students is rejected as there is significant difference at the .01 level.

The data presented in Table 9 was compiled by taking the perceptual difference scores between teachers and students on each question. The absolute value of the difference of average perceptions of teachers and students was compiled, which becomes the average perceptual difference between each student and his/her teacher. To determine if this average difference is greater for males or females, a t-test was utilized to analyze the compiled average perceptions.

Table 9 reveals there is a significant difference at the .01 level in the perceptions of females to males when responding to the forty perceptual questions on the Teaching-Learning Process Analysis Inventory. The male students' mean is 1.23, which is higher than the female students' mean of 1.15. The female responses, therefore,

Table 8

Inventory Questions which Indicate a Significant Difference at the .05 Level in the Perceptions of Students of Teacher Expectations and Algebra Grades

Inventory Questions	R-Value	Significance
1. ...I would prefer to have the teacher do all of the planning of assignments and class activities...	-.1448	.000
2. ...I work the way I do in the class because I feel I am helping myself...	-.1144	.006
3. ...I dislike starting the class and I look forward to its end...	-.1052	.011
4. ...I am satisfied with the class activities and assignments...	-.1470	.000
5. ...my classmates and I discuss in class our feelings about ourselves and our feelings about each other...	-.0840	.042
6. ...we listen to the teacher lecture or give demonstrations without a chance to discuss or ask questions...	-.1803	.000
7. ...we are permitted to discuss or ask questions while we are listening to the teacher lecture or give demonstrations...	-.1746	.000
8. ...the teacher helps me think through and work out my own difficulty or problems when I ask the teacher for help...	-.0838	.043
9. ...my classmates and I feel relaxed and happy as we go about doing our class work...	-.2081	.000
10. ...we talk about our problems and get rid of our unpleasant feelings...	-.1150	.005
11. ...we talk about how we feel about what we learn...	-.1274	.002
12. ...I am happy to get back a test I have taken...	-.2419	.000

were concluded to be more critical than those of male students when comparing their perceptions of the teachers' expectations. Thus, it was observed that females do have different perceptions than males of the teachers' expectations.

Table 9

Mean Perceptual Difference Scores of Male and Female Students

Group	Number Cases	Mean	S.D.	T-Value	D.F.	Critical Value
Males	242	1.2260	.319	2.79	472.89	.006*
Females	289	1.1535	.271			

*Significant at the .01 level.

The following tables, 10 through 49, report the results of the perceptions of the teachers and the students on the Teacher-Learning Process Analysis Inventories. Hypothesis Three stated: There are no differences in the perceptions of teachers and students for the forty algebra learning expectations. In all of the tables, there were 531 student cases with each case responding to forty learning expectations and fifteen teacher cases with each case responding to forty learning expectations. The summary tables column headings in need of interpretation are: V^1 is equal to the teacher response to Learning Expectation One through

Learning Expectation Forty V^{40}. Learning Expectation Forty-one, V^{41}, is equal to the students' response to Learning Expectation One through Learning Expectation Forty being equal to V^{80}. The mean would equate to the percentile time allocation segment indicated on the teachers' and students' inventory. The mean numbers fall within a range of one through five. Each time zone, 1 = 0-5 percent, 2 = 25-33 percent, 3 = 33-65 percent, 4 = 66-95 percent, and 5 = 95-100 percent, was divided into equal quarters for clarity and accuracy of analysis. S.D. is the abbreviation for standard deviation and D.F. indicates degrees of freedom with remaining columns being self-explanatory.

Table 10 shows a significant difference at the .01 level in preference by the students and teachers in the planning of assignments and class activities. The table reveals that the teachers perceived they should plan the assignments and classroom activities substantiated by a mean of 4.26 or at the upper quarter of the 66-99 percent time zone. The students perceived that it should be a shared activity as indicated by their mean response of 3.47 within the percentage range of 33-66 which is in the second quarter of the time zone allocation.

Table 10

Importance of the Preference to have the Teacher do all the Planning of Assignments and Class Activities

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{1}	4.2580	1.185	11.08	53	.000*
V^{41}	3.4708	1.106			

*Significant at the .01 level.

Table 11 reveals that there was significant difference at the .01 level of the preference by students and teachers in working with the students planning their individual assignments and classroom activities. The table shows that the teachers perceived that they should work with the students at a mean of 2.47 which is in Time Zone Two, or 5-33 percent of the time, which is the lower quarter of the time zone. The students perceived that the teacher should work with them on planning individual assignments and class activities to a lesser degree which was supported by a mean of 1.91 or of 5-33 percent of the time zone which is the fourth quarter of Time Zone One. Thus, it could be concluded that teachers perceived it as important that they work with students individually in planning, but students did not perceive that this happened.

Table 11

Preference to have the Teacher Work with the Students in Planning their Individual Assignments and Class Activities

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^2	2.4652	1.345	7.68	531	.000*
V^{42}	1.9077	1.002			

*Significant at the .01 level.

Table 12 indicates that there is significant difference at the .01 level in preference by the teachers and students in having the class as a whole working together in planning assignments and class activities. The table reveals that teachers perceived this should happen at the lower quarter of the Time Zone Two at a mean of 2.24 which places the mean score in the percentage range of 5-33, while the students perceived that it should happen at the third quarter of the Time Zone Two within a percentage range of 5-33 or a mean of 2.60. Therefore, it could be concluded that the students perceived it to be more important to work together in planning class activities than did the teachers.

Table 12

Importance of the Preference of the Whole Class Working with the Teacher in Planning Assignments and Activities

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{3}	2.2392	1.345	-4.47	53	.000*
V^{43}	2.6008	1.002			

*Significant at the .01 level.

Table 13 shows that there is significant difference at the .01 level of the perceptions of teachers and the students about students working with the teacher in planning assignments and class activities. Though the difference was not as great, as demonstrated by the teachers mean of 2.32, which positioned it in the second quarter of Time Zone Two or the 5-33 percentage range. However, the students were at 2.56 mean of the third quarter in the 5-33 percentage range of Time Zone Two, indicating they felt it was more important for the class to take part in the planning of assignments and class activities than did the teacher.

Table 13

Importance of the Whole Class Preferring to Work with the Teacher in Planning the Assignments and Class Activities

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{4}	2.3202	1.022	3.29	531	.001*
V^{44}	2.5556	1.273			

*Significant at the .01 level.

Table 14 reveals that there was not a significant difference in the perceptions of the teacher and student as to whether the students work the way they do because they feel they are helping themselves. Thus the null hypothesis is not rejected. Both groups agrew within the upper quarter of the 33-66 percentage range of Time Zone Three.

Table 14

Students Work the way They do in Class because They Feel They are Helping Themselves

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{5}	3.4614	.599	-1.11	53	.260*
V^{45}	3.5198	1.087			

*Not significant at the .05 level

Table 15 shows that there is a significant difference at the .01 level in the perceptions of the teacher and students about the amount of time the teacher spends lecturing and demonstrating. The teachers saw themselves lecturing and demonstrating more than did their students at a mean of 4.05, which is the lower quarter of Time Zone Four, placing it in the percentage range of 66-95. The students mean of 3.80, which is the upper quarter of Time Zone Three as shown by the percentage of 33-66, would show that the students do not perceive the teachers lecturing or demonstrating as much as the teacher perceived the activity.

Table 15

Importance of Listening to the Teacher or Watching the Teacher Demonstrate

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{6}	4.0490	.709	537	531	.000*
V^{46}	3.8023	.981			

*Significant at the .01 level.

Table 16 would indicate that the teacher and students agree that the work is not too difficult for students in introductory algebra. There is no significant difference, therefore the null hypothesis is not rejected.

Table 16

Perceptions in this Class are that the Work is too Difficult Rather than about Right for the Students of this Age and Grade

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^4	2.1770	1.566	1.84	531	.006*
V^{47}	2.0301	1.049			

*Not significant at the .05 level.

Table 17 reveals there is a significant difference at the .01 level in the perceptions of the teachers and the students as to the lack of necessary background and its effects on their work. The students' perceptions indicated their work is effected minimally as revealed by a mean of 1.80 or the upper quarter of the 0-5 percentage range of Time Zone One, whereas the teacher perceptions indicated that the students' work is effected at 2.27 mean or the lower quarter of the 5-33 percentage range of Time Zone Two. The teachers perceived that the students' work does suffer due to the lack of experience and background, and at greater degree than the student perceived. This would reveal that the teachers have not brought out the need for background and experience and its importance to algebra.

Table 17

Students' Work Suffers because They Lack Necessary Experience and Background

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{8}	2.2655	1.566	7.41	531	.000*
V^{48}	1.8004	1.049			

*Significant at the .01 level.

Table 18 shows there is a significant difference at the .05 level in the perceptions of the teachers and the students as to the interest of both parties getting started personally and working on class activities. The students' perceptions are at the 1.80 mean or the upper quarter of the 0-5 percentage range of Time Zone One. The 3.60 mean score of the teacher which is in the upper quarter of the 33-66 percentage range of Time Zone Three, shows the teachers are considerably more interested in starting and working on activities in class than the students. This would indicate that the teachers have not communicated their interests and desires to the students.

Table 18

Teachers' and Students' Interest in Getting Started and Working on Class Activities

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{9}	3.6026	1.100	25.37	531	.000*
V^{49}	1.8004	1.074			

*Significant at the .05 level.

Table 19 reveals there is a significant difference at the .01 level in the perceptions of the teachers and students as to the other individuals' desire to get started and work on class activities. The teachers perceived the students' desire to get started at the 3.60 mean or the third quarter of Time Zone Three which is a percentage range of 33-66. The students perceived the teachers' interest to get started on class activities at a mean of 2.62 or the third quarter of the second time zone or a percentage range of 5-33. It could be concluded that the teachers perceived the students to be more prepared to work than the students perceived the teacher ready to teach. Again, there is evidence of the lack of communication by the teachers as to their intentions, desires, and motivation to begin learning.

Table 19

Perceptions of Teachers and Students of the Other on Getting Started and Working on Class Activities

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{10}	3.6026	1.100	13.20	531	.000*
V^{50}	2.6215	1.325			

*Significant at the .01 level.

Table 20 indicates that there is a significant difference at the .05 level in the perceptions of students and teachers and their dislike of the class and their desire for it to end. The teachers mean of 1.45 or the second quarter of Time Zone One, which is a percentage range of 0-5 of the time would reveal that they were not dissatisfied with the class nor looked forward to its end. The students' mean of 2.62, which is in the third quarter of Time Zone Two within the percentage of 5-33, that the students did dislike the class at least a third of the time and look forward to its end considerably more than the teachers. The teachers did not project their enthusiasm for the class to their students according to the table.

Table 20

Teachers and Students Dislike of Starting the Class and Their Desire for it to End

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{11}	1.4520	1.074	14.79	531	.000*
V^{51}	2.6215	1.325			

*Significant at the .05 level.

Table 21 shows there is a significant difference at the .01 level in the perceptions of teachers and students in their view of each other as to their dislike in getting the class started and looking forward to its end. Teachers' perceptions reveal that they felt students disliked the class at a mean of 2.41 which is in the second quarter of Time Zone Two in the percentage range of 5-33. This is comparable to the students self-perceptions on Table 20. The students' perceptions show that the teachers disliked the class at a mean of 1.87, which is in the fourth quarter of Time Zone One in the percentage range of 0-5 of the time. It could be concluded, when comparing Tables 20 and 21, that the teachers perceived students were displeased with starting the class and looked toward its end less often than the students perceived themselves.

Table 21

Teachers' and Students' Perception of each Other as to the Dislike of Starting the Class and Looking Forward to its End

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{12}	2.4143	.982	326	531	.000*
V^{52}	1.8663	1.164			

*Significant at the .01 level.

Table 22 reveals there is a significant difference at the .05 level in the perceptions of teachers and students as they relate to individual assignments and activities which are provided for various members of the class to allow for differences in interests, backgrounds, and experiences. The teachers and students both indicated that it happens infrequently though the students perceived it taking place more than the teachers. Students ranged in the third quarter of Time Zone One at a mean of 1.57 and the teachers ranked it in the second quarter of Time Zone One at a mean of 1.44, which falls into the percentage range of 0-5.

Table 23 shows that there is a significant difference at the .01 level in the perceptions of students and teachers as to whether the assignments and activities are of practical value to the student. Both the teacher and students were in the same percentage range, 33-66 with the teachers

in the third quarter of the time zone and the students in the second quarter of Time Zone Three. The teachers' mean was 3.63, with the students' mean being 3.38. This would indicate that the teachers perceived the assignments more useful than the students, at the upper quarter of the time zone, though both groups perceived the assignments and class activities useful the majority of the time.

Table 22

Individual Assignments and Activities are Provided for Various Members of the Class to Allow for Differences in Interests, Backgrounds, and Experience

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{13}	1.4426	1.074	-2.06	531	.040*
V^{53}	1.5725	.970			

*Significant at the .05 level.

Table 23

Students' and Teachers' Perceptions as to whether the Assignments and Class Activities are Practical and Useful

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{14}	3.6328	1.149	3.56	531	.000*
V^{54}	3.3804	1.091			

*Significant at the .01 level.

Table 24 indicates there is not a significant difference at the .05 level. Therefore, the null hypothesis is not rejected as there is not significance in the perceptions of the students and the teachers as to whether the teachers give students practice in looking for places outside the classroom where they might use what they have learned.

Table 24

The Teacher Gives the Students Practice in Looking for Opportunities in Non-school Settings in the use of Algebra

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{15}	2.1544	1.227	-1.31	531	.192*
V^{55}	2.2486	1.213			

*Not significant at the .05 level.

Table 25 reveals that there is significant difference at the .01 level in the perceptions of teachers and students in whether the teachers give the students practice in understanding how students might wrongly use outside the classroom what they have learned. Teachers and students both indicated that this does not happen regularly in the classroom as born out by the percentage range of 0-5 in Time Zone One. The teachers' mean was 1.64 or the third quarter of the first time zone whereas the students' mean perception of 1.85 of the practice happing is in the fourth quarter of the first time zone. It could be concluded

that both groups perceived that practical application of algebra is seldom applied in the classroom.

Table 25

The Teachers Give the Students Practice in Understanding how Students Might Wrongly use what They have Learned in Non-school Settings

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{16}	1.6403	1.066	-3.23	531	.001*
V^{56}	1.8475	1.034			

*Significant at the .01 level.

Table 26 shows there is a significant difference at the .05 level in the perceptions of the teachers and students as to whether both parties prefer having the student working alone during the class period and not consulting the teacher. The mean for the teachers of 1.85 which is the fourth quarter of Time Zone One in the percentage range of 0-5 of the time would demonstrate that the teachers did not wish this to happen often; however, the students' mean of 2.02, which is in the first quarter of Time Zone Two in the percentage range of 5-33 would indicate they felt they preferred to work alone, some without consulting or talking to the teacher. Again, communication between the teachers and the students is lacking in understanding each others' needs.

Table 26

Students' and Teachers' Perceptions of the Students Working Alone during the Class Period and not Consulting or Talking with the Teacher

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{17}	1.8512	1.242	-2.20	531	.028*
V^{57}	2.0183	1.173			

*Significant at the .05 level.

Table 27 reveals that there is a significant difference at the .01 level in the perceptions of teachers and students as to whether students should work alone but with the right to consult or talk with the teacher. Both groups perceived that this should take place at the 33-66 percentage range of the third time zone though the teachers saw it as more important as demonstrated by their mean of 3.91, which is in the fourth quarter of Time Zone Three whereas the students' mean score of 3.57 falls into the third quarter of the time zone, would show it to be important and that it does take place often though they do not see it occurring as frequently as teachers.

Table 28 shows there is a significant difference at the .01 level in the perceptions of teachers and students as to the preference of students to work alone but with the right to consult or talk with classmates when they wish. Students' preference was at a mean of 3.73 which falls into

the third quarter of Time Zone Three in the 33-66 percentage range. The teachers' preference was a mean of 2.73, which is in the fourth quarter of Time Zone Two which is the 5-33 percentage range. Students perceived it to be more important to talk to peers about work than did teachers. Students perceived it to be equally important to talk to peers and the teacher, see Table 27, when they needed assistance. However, teachers did not see students discussing with students to be as important as consulting the teacher.

Table 27

Teachers' and Students' Perceptions of the Student Working Alone but with the Right to Consult or Talk with the Teacher

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{18}	3.9096	1.189	4.43	531	.000*
V^{58}	3.5725	1.293			

*Significant at the .01 level.

Table 28

Perceptions of Teachers and Students as to the Preference of Students to Work Alone but with the Right to Consult or Talk with Classmates when They Wish

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{19}	2.7797	1.597	-11.39	531	.000*
V^{59}	3.7307	1.206			

*Significant at the .01 level.

Table 29 indicates that there was a significant difference at the .01 level in the perceptions of students and teachers whether students should work cooperatively with small groups of classmates. Students revealed through their mean of 3.27, which is in the second quarter of Time Zone Three, placing them in the 33-66 percentage range, that they perceived it to be more important to them to work in small groups than did their teachers. The teachers' mean of 2.09 fell into the first quarter of Time Zone Two which was in the 5-33 percentage range, indicating they did not perceive this to be as important as did the students. When comparing Tables 27, 28, and 29, it is evident that teachers felt they were the major source of information. The students indicated they would prefer to use all sources and methods to gain knowledge about algebra.

Table 29

Perceptions of Teachers and Students in Students' Preferences in Working Cooperatively with Small Groups of Classmates

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{20}	2.0885	1.123	-16.92	531	.000*
V^{60}	3.2655	1.341			

*Significant at the .01 level.

Table 30 shows there was a significant difference at the .01 level in the perceptions of teachers and students concerning the satisfaction of students with class activities and assignments. Both groups were in Time Zone Three, which computed to the 33-66 percentage range. The teachers were in the fourth quarter of the time zone while the students were in the second quarter of the time zone.

Table 30

Perceptions of Teachers and Students as to the Students' Satisfaction with Class Activities and Assignments

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{21}	3.7872	.410	7.72	531	.000*
V^{61}	3.4063	1.041			

*Significant at the .01 level.

The results show that the teachers perceived students were more satisfied with the class activities and assignments than did the students.

Table 31 reveals that there was a significant difference at the .01 level in the perceptions of students and teachers and relative to the students being permitted to explore and to talk freely concerning their feelings about the class. Teachers perceived students were permitted to explore and discuss freely during the class in the second quarter of the third time zone which was indicated by the mean of 3.32 which is in the percentage range of 33-66. Students did not have the same perceptions as indicated by their mean of 2.62, which placed them in the third quarter of the second time zone or in the 5-33 percentage range. Their perceptions were obviously less than the teachers.

Table 31

Perceptions of Teachers and Students as to the Students being Permitted to Explore and to Talk Freely Concerning Their Feelings about this Class

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{22}	3.3220	1.503	7.77	531	.000*
V^{62}	2.6196	1.300			

*Significant at the .01 level.

Table 32 shows there was a significant difference at the .01 level in the perceptions of teachers and students as to the students discussing their feelings about the class. The students perceived that they discussed their feelings about the class more often than the teachers perceived that they discussed their feelings. This is evident by the students' mean of 2.83, which is in the fourth quarter of Time Zone Two, which is in the percentage range of 5-33. The teachers' mean is 1.90, which is in the fourth quarter of Time Zone One or at a percentage range of 0-5, which indicates that the class seldom discussed feelings about the class.

Table 32

Perceptions of the Teachers and Students of Whether the Students Discuss their Feelings about the Class

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{23}	1.9040	.950	-13.17	531	.000*
V^{63}	2.8267	1.358			

*Significant at the .01 level.

The table would indicate that the students discuss the class among themselves considerably more than the teacher is aware and Table 31 when compared with Table 32 would indicate the teachers perceived that the activity is allowed to take place frequently but they do not perceive that it

does take place. Students are consistent in how often discussion concerning the class is allowed and how frequently it takes place.

Table 33 indicates that there was a significant difference at the .01 level in the perceptions of teachers and students about students discussing their feelings about themselves and other students in the class. Teachers perceived that it did not happen often and significantly less than the students perceived the discussions happening. Neither group perceived it to take place with any frequency. The teachers' mean is 1.33 or the second quarter of Time Zone One, which is a percentage range of 0-5. The students' mean is 1.75, or in the third quarter of Time Zone Three, which is the same percentage range of the teachers.

Table 33

Perceptions of Teachers and Students as to Students Discussing their Feelings about Themselves and each Other in Class

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{24}	1.3296	.649	-7.47	531	.000*
V^{64}	1.7476	1.116			

*Significant at the .01 level.

Table 34 shows there was a significant difference at the .01 level in the perceptions of the teachers and

students discussing in class ways of getting along with each other and ways of feeling more pleasant about themselves and others. The teachers' and students' perceptions were both in the 0-5 percentage range though the teachers were in the second quarter of the first time zone as shown by their mean of 1.27. The students perceive it to happen more often in the class but not major portions of the class time. Teachers felt it happened less than the students. Both groups felt it seldom occurred. This is revealed by the students' mean of 1.52 which is the third quarter of Time Zone One.

Table 34

Perceptions of Teachers and Students about Students Discussing in Class Ways of Getting Along with each Other and Ways of Feeling more Pleasant about Themselves and Others

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{25}	1.2655	.442	-5.54	531	.000*
V^{65}	1.5179	.908			

*Significant at the .01 level.

Table 35 revealed that the perceptions of teachers and students of the teachers lecturing or giving demonstrations without a chance to discuss or ask questions was not a condition which happened a majority of the time in the class. Students felt it happened more often than did the teachers

as shown by their mean of 1.75, which is in the third quarter of Time Zone One in the percentage range of 0-5. The teachers were in the same percentage range, though their mean of 1.10 places them in the first quarter of Time Zone One.

Table 35

Perceptions of Teachers and Students of Teachers Lecturing or Giving Demonstrations without a Chance to Discuss or Ask Questions

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{26}	1.0998	.300	-13.04	531	.000*
V^{66}	1.7476	1.123			

*Significant at the .01 level.

Table 36 indicates that there was a significant difference at the .01 level in the perceptions of teachers and students as to whether the students are permitted to discuss or ask questions while the teacher is lecturing or asking questions. Both groups perceived that the students could ask questions at a percentage range of 66-95 percent of the time. However, the teachers perceived it to be a more frequent occurrence as shown by their mean of 4.75 which places them in the third quarter of Time Zone Four, indicating that questions and discussion did not occur as frequently as the teachers perceived it to happen. In

comparing Table 35 to Table 36 there is support for Table 36 in that students and teachers perceived that they did have the opportunity to discuss and ask questions.

Table 36

Perceptions of Teachers and Students as to whether the Students are Permitted to Discuss or Ask Questions while the Teacher is Lecturing or Asking Questions

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{27}	4.7476	.435	10.93	531	.000*
V^{67}	4.1751	1.169			

*Significant at the .01 level.

Table 37 reveals that there was a significant difference at the .01 level in the perceptions of students and teachers in students memorizing facts or other materials. Both groups responded in the same time zone at a percentage range of 5-33 percent of the time. Students perceived that they had to memorize to a greater extent than the teachers perceived they had to and this is revealed by the students' mean of 2.70, which is in the third quarter of the time zone. The teachers' mean of 2.46, which is in the second quarter of Time Zone Two, would indicate less significance than the students.

Table 37

Perceptions of Teachers and Students as to whether Students have to Memorize Facts or Other Materials

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{29}	2.4596	1.011	-3.58	531	.000*
V^{69}	2.7024	1.186			

*Significant at the .01 level.

Table 38 shows there was significant difference at the .01 level in the perceptions of the teachers and students as to the teachers availability to give the student help when they desire it. Teachers perceived that they were able to give help less than the students perceived them carrying out the activity. This is evident by the mean of 3.25 which placed the teachers in the first quarter to Time Zone Three in a percentage range of 33-66, whereas the students perceived they were helped at a mean of 4.06 or the first quarter of Time Zone Four, placing the students' perceptions of the frequency of this activity in the 66-95 percentage range.

Table 38

Perceptions of Teachers and Students as to whether the Teacher is Available to Give the Student Help when They Desire It

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{29}	3.2486	1.157	-11.94	531	.000*
V^{69}	4.0546	1.026			

*Significant at the .01 level.

Table 39 reveals there was a significant difference at the .01 level in the perceptions of the students and teachers in helping students to think through and work out their own difficulties or problems. Teachers perceived that they helped students at a percentage range of 66-95 percent of the time which is in the first quarter of Time Zone Four as shown by their mean of 4.18. However, students perceived it to happen less frequently as indicated by their mean of 3.82, which is in the fourth quarter of Time Zone Three for a percentage range of 33-66. Both groups perceived that students received help frequently in the class.

Table 40 indicates there was a significant difference at the .01 level in the perceptions of teachers and students as to whether students felt relaxed and happy as they went about their class work. Both groups were in the same percentage range of 33-66, though teachers perceived the students were more relaxed and happy than did the students.

This is shown by the teachers' mean of 3.97, which is the fourth quarter of Time Zone Three while the students' mean of 3.09 placed them in the first quarter of Time Zone Three. Students perceived themselves to be relaxed about a third of the time and the teachers were at the other extreme of Time Zone Three, perceiving the students to be relaxed two-thirds of the time.

Table 39

Perceptions of Teachers and Students of the Teachers Helping Students to Think through and Work Out Their Own Difficulties or Problems

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{30}	4.1846	.641	6.64	531	.000*
V^{70}	3.8192	1.132			

*Significant at the .01 level.

Table 40

Perceptions of Teachers and Students as to whether Students Feel Relaxed and Happy as They go About Doing their Classwork

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{31}	3.9680	.577	15.52	531	.000*
V^{71}	3.0942	1.150			

*Significant at the .01 level.

Table 41 indicates that there was a significant difference at the .01 level in the perceptions of students and teachers as to students talking about their problems and getting rid of their unpleasant feelings. Both groups were in Time Zone One which is in the percentage range of 0-5. Teachers' perceptions were as significant as the students which is demonstrated by the mean of 1.52, placing it in the third quarter of Time Zone One. The students' mean of 1.91 was in the third quarter of Time Zone One, indicating that there was infrequent discussion in the classroom about students' problems or feelings.

Table 41

Perceptions of Teachers and Students as to Students Talking about their Problems and Getting Rid of their Unpleasant Feelings

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{32}	1.5193	.854	-6.68	531	.000*
V^{72}	1.9053	1.060			

*Significant at the .01 level.

Table 42 shows that there was a significant difference at the .01 level in the perceptions students and teachers have concerning the students talking about what they feel they have learned. The teachers' mean of 1.30, which is in the fourth quarter of Time Zone One, in the percentage range

of 0-5, indicated that the students do not talk about how they feel about what they have learned. The students' mean of 2.11 placed them into the first quarter of Time Zone Two, which is in the percentage range of 5-33. The students perceived that they discussed what they had learned more frequently than did the teachers.

Table 42

Perceptions of Teachers and Students about the Students' Talking about what They Feel They have Learned

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{33}	1.7985	.734	-5.31	531	.000*
V^{73}	2.111	1.118			

*Significant at the .01 level.

Table 43 demonstrates there was no significance at the .05 level.

Table 43

Perceptions of Teachers and Students about how Students' Ideas are Changing

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{34}	1.6271	.659	-1.72	531	.087*
V^{74}	1.7137	.976			

*Not significant at the .05 level.

Table 44 indicates there was a significant difference at the .05 level in the perceptions of teachers and students talking about how changes will affect the student in later life. Both teachers and students were in Time Zone One, which is in the 0-5 percent range. Teachers felt it was more significant than students as their mean of 1.92 was in the fourth quarter of Time Zone One, while the students' mean of 1.77 placed them in the lower range of the fourth quarter of Time Zone One. Teachers and students perceived that they infrequently discussed changes and the effect on later life.

Table 44

Perceptions of Teachers and Students as to whether the Teachers and Students Talk about how these Changes will Affect the Student in Later Life

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{35}	1.9228	.953	2.46	531	.014*
V^{75}	1.7740	.995			

*Significant at the .05 level.

Table 45 indicates there was no significance at the .05 level.

Table 45

Perceptions of Teachers and Students as to Students Taking Tests to Decide what Grade They will Get in Class

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{36}	3.5706	1.438	.44	531	.568*
V^{76}	3.5367	1.241			

*Not significant at the .05 level.

Table 46 reveals that there was a significant difference at the .01 level in the perceptions of students and teachers as to students' happiness to get back tests they had taken. Both groups' perceptions were in Time Zone Three, which is in the percentage range of 33-66 with the teachers' mean of 3.60 placing them in the upper quarter of Time Zone Three while the students' mean of 3.19 placed them in the first quarter of the same time zone. Teachers and students both perceived they wished to get back tests but teachers perceived the students' happiness to be greater than the students perceived it.

Table 47 shows that there was a significant difference at the .01 level in the perceptions of teachers and students as to the teachers working with the students to discover the errors they made during tests. The teachers' mean of 4.11 placed them in the first quarter of Time Zone Four in the percentage range of 66-95. The students did not perceive

that the teachers worked with them at the same level as the perceptions of the teachers as shown by their mean of 3.84, which is in the fourth quarter of Time Zone Three in the percentage range of 33-66.

Table 46

Perceptions of Teachers and Students as to Students' Happiness to Get Back Tests They have Taken

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{37}	3.5951	.626	7.48	531	.000*
V^{77}	3.1921	1.209			

*Significant at the .01 level.

Table 47

Perceptions of Teachers and Students as to the Teacher Working with the Students to Discover the Errors They Made during Tests

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{38}	4.1130	1.110	4.62	531	.000*
V^{78}	3.8362	1.142			

*Significant at the .01 level.

Table 48 reveals that there was a significant difference at the .01 level in the perceptions of teachers and students as to the teacher working with the students to help them understand what they did wrong and why they made

errors during tests. The teachers' mean of 4.24 places them in the fourth quarter of Time Zone Four, at a percentage range of 66-95. The students' mean of 3.97 does not agree with the teachers placing them in the fourth quarter of Time Zone Three, which is a percentage range of 33-66. Table 47 and 48 do correspond in that the teacher works consistently with the student on correcting errors but the students see it happening less frequently than the teacher.

Table 48

Perceptions of Teachers and Students as to the Teacher Working with Students to Help Them Understand what They did Wrong and Why They Made Errors during Tests

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{39}	4.2354	1.053	4.57	531	.000*
V^{79}	3.9661	1.079			

*Significant at the .01 level.

Table 49 indicates there was a significant difference in the perceptions of students and teachers as to whether students would prefer to take tests. Teachers and students were both in Time Zone Two, which is in the 5-33 percent range. The teachers perceived students would prefer tests more often than the students indicated they would, as indicated by their mean of 2.71, which is in the third quarter of the time zone. The students' mean of 2.22 places

them in the first quarter of the time zone.

Table 49

Perceptions of Teachers and Students as to Whether Students would Prefer to Take Tests

Group	Mean	S.D.	T-Value	D.F.	Critical Value
V^{40}	2.7100	1.033	7.17	531	.000*
V^{80}	2.2185	1.204			

*Significant at the .01 level.

The statistical material presented in Table 50 reveals that Hypothesis Four: There is no difference in the mean algebra achievement score of male and female students, was retained and could not be rejected because there was not a significant difference between means x^1 and x^2. The mean symbols x^1 and x^2 in the table indicate sex of the sample. X^1 is equal to male students and x^2 is equal to female students. From the data in Table 49, it is evident that the critical level of significance was at .547 exceeding the .05 level. The table shows that achievement did not vary significantly between male and female introductory algebra students.

Table 50

Importance of Sex on the Algebra Achievement Score in the Introductory Algebra Classroom

Group	Cases	Mean	S.D.	T-Value	D.F.	Critical Value
x^1	242	2.6863	.935	-.60	512.73	.547
x^2	284	2.7356	.944			

*Significant at .05 level.

Chapter Four has been a presentation of the statistical results obtained from the gathered data. In Chapter Five, findings of the study, conclusions, and recommendations are presented.

CHAPTER FIVE

Summary, Conclusions and Recommendations

The purpose of this study was to obtain perceptions of algebra teachers and introductory algebra students of learning expectations and the effects on achievement in eight central Iowa high schools of similar size and communities similar in population and economic composition.

Procedures

Two correlated instruments were utilized in the study for 636 introductory algebra students and fifteen algebra teachers in eight central Iowa high schools. The students and teachers were requested to complete forty questions on the correlated Teaching Learning Process Analysis Inventories and return them to the high school counselor. The inventory questions requested the respondents to describe the amount of time spent on activities in the class. Five time indicators were utilized ranging from zero (0) percent to 100 percent.

The high school counselor correlated the students' inventory to their achievement grade for the first semester and also the students' score on either the Iowa Algebra Aptitude Test or the Iowa Test of Educational Development, the quantitative thinking segment, and returned the data

at the end of the first semester with the teachers' responses which correlated to the students. All teachers returned the inventories completely answered, however, 627 of 636 students returned surveys for a percentage return of 98.6. The students who responded to all forty questions numbered 588 of 627 for a percentage of 93.78.

The inventories were grouped and the data were tabulated in each of four categories: algebra teachers, algebra students, sex of algebra students, and grade point averages of the students.

A Pearson Product-Moment Correlation was utilized to test the outcomes related to Hypothesis One. The correlation is a parametric technique employing continuous data. The .05 level of significance was utilized to determine whether significant differences existed between the sample means. A Hotelling's T^2 multivariate analysis was conducted to test the outcomes of Hypotheses Two, Three and Four. The F value was calculated against the .05 critical value to determine if a significant interaction were present.

Findings

Hypothesis One was tested using the Pearson Product-Moment Correlation:

> There is no relationship between perceptual difference scores and algebra grades.

The results of the Pearson Product-Moment Correlation indicated that there were twelve of forty inventory questions

which showed a significant difference at the .05 level within the following tasks in the classroom:

> ...I would prefer to have the teacher do all of the planning of assignments and class activities.
>
> ...I work the way I do in the class because I feel I am helping myself.
>
> ...I dislike starting the class and I look forward to its end.
>
> ...I am satisfied with the class activities and assignments.
>
> ...my classmates and I discuss in class our feelings about ourselves and our feelings about each other.
>
> ...we listen to the teacher lecture or give demonstrations without a chance to discuss or ask questions.
>
> ...we are permitted to discuss or ask questions while we are listening to the teacher lecture or give demonstrations.
>
> ...the teacher helps me think through and work out my own difficulty or problems when I ask the teacher for help.
>
> ...my classmates and I feel relaxed and happy as we go about doing our class work.
>
> ...we talk about our problems and get rid of our unpleasant feelings.
>
> ...we talk about how we feel about what we learn.
>
> ...I am happy to get back a test I have taken.

Only twelve of forty questions or 30 percent were significant at the .05 level with none of the questions having a significant difference. All of the twelve questions had a negative relationship (Table 10) thus indicating that students with high grades did not perceive the expectations

of their teachers. Also, the seven questions (Table 9) of the forty which had a positive relationship, indicating that students with high grades perceived the teachers expectations, were not significant at the .05 level.

The findings indicate that there is not a relationship between high grades and understanding what the teacher expects in the classroom. Table 10 would indicate that 30 percent of the time the reverse is true, the student does not perceive the teachers' expectations, though they receive high grades. Additional findings indicate that there was a negative correlation on thirty-three of the forty questions or 82.5 percent indicating the students did not perceive the teachers' expectations regardless of the students' grades.

Hypothesis Two was tested using the Hotelling's T^2 Test:

> There is no difference in the mean perceptual difference scores of male and female students.

The data in Table 11 indicates that significance did occur in the t-test. The findings indicated that male and female students do perceive teachers expectations differently with the female students being more critical than the male students.

Hypothesis Three was tested using the Hotelling's T^2 Test:

> There are no differences in the perceptions of teachers and students for the forty algebra learning expectations.

The forty questions on the teachers' and students' inventories using the T^2 Test were tabulated in Tables 12 through 49. Thirty-five or 87.5 percent of the questions were significant at the .05 level.

The forty questions were grouped into seven related categories ranging from four to eight questions in each category.

The following eight questions are grouped in category one:

> ...I would prefer to have the teacher do all of the planning of assignments and class activities.
>
> ...I would prefer to work with the teacher in planning my own individual assignments and class activities.
>
> ...I would prefer having the whole class work with the teacher in planning activities and class activities.
>
> ...I feel the whole class should work with the teacher in planning assignments and class activities.
>
> ...I would prefer to work alone during the class period without consulting or talking with the teacher.
>
> ...I would prefer to work alone but with the right to consult or talk with the teacher.
>
> ...I would prefer to work alone but with the right to consult or talk with my classmates when I wish.
>
> ...I would prefer to work cooperatively with small groups of classmates.

The findings as displayed in Tables 10, 11, 12, 13, 27, 28, 29, and 30 show that all questions were significant at the .05 level with the teachers and students in

disagreement as to the involvement in classroom assignments and activities.

Table 13 shows that teachers on individual assignments and activities perceived they should work with the student in planning, though the students perceived that they should be more independent in individual planning of assignments and activities.

The finding demonstrates in all eight tables that students perceive they should be involved in decision making when class activities, assignments and working with others is the objective of the classroom teacher.

The following five questions are grouped in category two:

> ...I work the way I do in the class because I feel I am helping myself.
>
> ...the work is too difficult rather than about right for me and the students of my age and grade.
>
> ...my work suffers because I lack necessary experience and background.
>
> ...I feel my assignments and class activities are of practical-useful value to me.
>
> ...I am satisfied with the class activities and assignments.

The findings show that Tables 12, 25, and 32 are significant at the .05 level and that Tables 14 and 16 are not significant at the .05 level.

The students perceived that their work did not suffer because of the lack of experience nor did they see the

assignments or activities as useful or practical. However, teachers perceived each of the questions the opposite of the students. The findings would indicate that teachers perceived each item in the group as more important to students than did the student.

The following five questions are grouped in category three:

> ...I am really interested in getting started and working on classroom activities.
>
> ...I feel that the teacher is interested in getting started and working on class activities.
>
> ...I dislike starting the class and I look forward to its end.
>
> ...I feel that the teacher dislikes starting the class and looks forward to its end.
>
> ...my classmates and I feel relaxed and happy as we go about doing our class work.

The findings indicate in Tables 18, 19, 20, 21, and 40 that all questions were significant at the .05 level with the teacher and student in disagreement as to the students' feelings and attitudes toward the class and the teacher.

The students were not as relaxed as the teacher perceived, nor as interested in getting the class started as the teacher. The findings indicate that teachers are more interested in the class than the students were and also the teacher did not radiate this interest as shown in Table 21.

The following six questions are grouped in category four:

> ...other class members and I are permitted to explore and to talk freely about our feelings about this class.

...my classmates and I discuss our feelings about this class.

...my classmates and I discuss in class our feelings about ourselves and our feelings about each other.

...my classmates and I discuss in class ways of getting along with each other and ways of feeling more pleasant about ourselves and others.

...we talk about our problems and get rid of our unpleasant feelings.

...we talk about how we feel about what we learn.

The findings indicate that Tables 31, 32, 33, 34, and 35 were significant at the .05 level. In all cases, the teachers did not perceive that the students discussed their feelings about the class. Students perceived that they discussed their feelings about each other and the class more frequently than the teacher perceived though it was not a frequent occurrence in either party's perceptions.

The following four questions are grouped into category five:

...we are listening to the teacher or watching the teacher demonstrate.

...we are permitted to discuss or ask questions while we are listening to the teacher lecture or give demonstrations.

...we have to memorize facts or other materials.

...we listen to the teacher lecture or give demonstrations without a chance to discuss or ask questions.

The findings demonstrate that Tables 15, 35, 36, and 37 are significant at the .05 level. Teachers perceived that they lectured often and were the center of the class activity

more often than did the students. The students perceived that they were not allowed to ask questions while the teacher was lecturing or demonstrating to the same degree of time in class as the teachers perceived the activity. Teachers also perceived that memorization was less a frequent occurrence than did the student. Again the perceptions of students and teachers were significantly different.

The following seven questions are grouped in category six:

> ...individual assignments and activities are provided for various members of the class to allow for differences in interests, backgrounds, and experiences.
>
> ...the teacher tries to give us practice in looking for places where we might use outside the classroom what we have learned.
>
> ...the teacher tries to give us practice in understanding how we might wrongly use outside the classroom what we have learned.
>
> ...the teacher is available to give me help when I desire help.
>
> ...the teacher helps me think through and work out my own difficulty or problems when I ask the teacher for help.
>
> ...we talk about how our ideas are changing.
>
> ...we talk about how these changes will affect us later in life.

The findings indicate that five of the seven tables, 22, 25, 38, 39, and 44, were significant at the .05 level. Tables 24 and 43 were not significant.

The students and teachers perceived that there were

infrequent discussions individually or in groups about application of what they have learned to later use or to individual differences. The teacher and students did not perceive the frequency to the same degree. This is demonstrated in Tables 22, 25, and 44. In Tables 38 and 39 the frequency of whether the teacher assisted the students with their work and solving difficulties happened often. The teachers perceived it to occur at a higher rate than did the students.

The following five questions are grouped into category seven:

> ...we take tests to decide what grade we will get in class.
>
> ...I am happy to get back a test I have taken.
>
> ...the teacher works with us to discover the error we have made during tests.
>
> ...the teacher works with us to help us understand what we did wrong and why we make errors during tests.
>
> ...I would prefer to take tests.

The findings demonstrate in Tables 46 through 49 that there is a significant difference at the .05 level. Table 45 was not significant.

In each of the four tables which were significant the teachers perceived that taking tests and related activities to testing happened more frequently than perceived by the students. Both groups perceived that testing was a frequent occurrence in the classroom and that they worked at

correcting errors on the tests. Students were not as interested in taking tests as the teachers perceived they were. Both groups perceived students' preferences not to take tests.

Hypothesis Four was tested using Hotelling's T^2 Test:

> There is no difference in the mean algebra achievement score of male and female students.

Table 50 would indicate that the mean of females was slightly higher than males. The findings indicate that there was not a significant difference at the .05 level; therefore, the hypothesis was not rejected.

It is worth noting that the mean GPA of the male and female students was 2.50 or a C+ average. Considering that the students involved were potentially the best math students in their chronological grouping, it would seem that their lack of perception of what the teacher perceived or expected in the class affected their achievement.

Conclusions

The purpose of this study was to investigate the relationship between introductory algebra students' and algebra teachers' perceptions of learning expectations and the effects on achievement. Significant relationship exists as reported in the findings of the study. The study did not fully support the research hypothesis though a number of conclusions can be drawn from the study.

1. The study indicated that the process of learning, the learning activities in which teachers and students participate, are important to the achievement of the students. Research by Evertson supports the findings. Her study found a clear relationship between teachers' beliefs, expectations, instruction practices, and achievement.[1] Therefore, poor communication and understanding of these activities result in a reduction of learning potential. This study would indicate that communication and expectations were poor between students and teachers.

2. The study found that the product, what takes place as a result of teaching, what the students have learned as measured by academic achievement and how they feel about the algebra class, does effect a student's achievement. This is supported by studies by McConnell and Bowers of forty-three algebra classes. They found that student learning was related to task orientation, clarity of presentation, frequent probing, enthusiasm and frequent teacher communication.[2]

3. The students in the eight high schools studied did

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[1]Carolyn Evertson, Student Achievement and Student Attitudes: Description of Selected Classrooms (Austin, TX: Univ. of Texas Research and Development Center for Teacher Education, 1979), pp. 79-84.

[2]John W. McConnell and Norman T. Bowers, "A Comparison of High-Inference and Low-Inference Measures of Teacher Behaviors as Predictors of Pupil Attitudes and Achievements." American Educational Research Association, San Francisco, CA, 1979.

not perceive the teachers' objectives and did not feel they understood what was expected. It demonstrated that the students who received the highest grades, and students in general, did so without clear knowledge of what the teacher expected. It should be noted that the students' grades were in the 2.68 for males to 2.73 or a C+ average which would indicate that better perceptions of teacher expectations would possibly enhance a student's achievement. It could be concluded that teachers' perceptions are related to high and low student achievement.

4. Differences in achievement scores (grades) for males and females were not significant having no effect on the perceptions on male or female students.

5. Differences in male and female perceptions of teacher expectations were significant with the female students being more critical than the male students.

6. Differences were significant in the perceptions of teachers and students in planning activities and assignments for the class and carrying out the assignments. The teachers were the focal point of the class retaining most of the decision making, infrequently involving the students in the process and apparently no perceiving the students' needs in the classroom.

7. Students did not see assignments as practical or useful, though the teachers perceived they were.

8. Students' attitudes about the algebra classroom were not as positive as the teachers and they did not have the same perceptions as the teachers as to starting or ending the class. The teachers were more interested in getting the class started than the students, though they did not communicate this attitude to the students.

9. Personal interaction about feelings was infrequent in the algebra classroom but students perceived it to happen more frequently than did the teachers.

10. Test taking and working on assignments were frequent occurrences in the algebra classroom perceived by both teachers and students. Teachers observed it to take place more often and to be more important than the students.

On the basis of the conclusions drawn from the data presented in this study, the following recommendations seem appropriate.

Recommendations

This section focuses on seven specific recommendations: (1) a replication of the present study, (2) experimentation with different subject matter, (3) implementation of companion studies exploring why there were more female than male students in the algebra classes, (4) recommendations to teachers to improve algebra achievement, (5) implementation of teacher training, (6) replication of the study analyzing algebra aptitude to achievement, and (7)

implementation of curriculum revision to encourage maximum achievement through appropriate teaching and learning.

1. This study should be replicated though it would be interesting to test a different population, possibly middle school students or advanced math students, controlling intelligence (I.Q.) and conducting the research over a greater length of time.

2. It is recommended that a similar study be undertaken with different subject matter such as science or English which is not as analytical a subject as algebra and observe if the perceptions of the teachers and students remain constant and if student achievement remains consistent.

3. It is recommended that a companion study exploring the facet of why more females were enrolled in the algebra classes than males be undertaken. This study showed that six of the eight schools had more female than male students and there were more females when all schools were combined. The demographic information indicated more females than males take algebra which is counter to national trends. It would be interesting to study whether this is an emerging social and cultural trend due to the changing laws of the land or is it a phenomena of Iowa or the geographic area of the eight high schools?

4. If the teacher in the algebra classroom is intent on improving the quality of her/his teaching, and improving

the product, the student, as reflected by high achievement, must endeavor to incorporate the following into their daily and long-term goals and expectations for his/her classrooms.

A. The students must understand the goals and expectations of the teacher for the course being taught.

B. The students must understand the objectives and expectations of the daily assignments of the teacher.

C. The teacher must know the students' capabilities in the subject from the first moment they enter the classroom, through utilization of pre/post testing and standardized tests. The teacher must also understand the differences psychologically of their students as it is effected by the sex of the student.

D. Teachers must seek out the students' perspectives about the course on a regular basis to insure growth and understanding.

E. Students need to be involved in the classroom planning and assignments. This is not to say that the teacher relinquish the responsibilities for classroom management, but involve the students in segments of the process, making it less teacher-centered and more "it is 'our' class" and "I want to be here," rather than "it is 'his or her' class and I can't wait for it to end."

F. Teachers must involve the students in the academic learning process using all students to assist in instruction and working with their peers rather than the instruction totally eminating from the instructor.

G. Teachers must radiate the genuine concern and enthusiasm for the subject to the student. This concern should be infectious in nature to enable the student to see the subject as practical and useful in and out of school.

5. Institutions of higher education must establish inservice and undergraduate programs which include courses in understanding and communicating with their students. Institutions of higher learning have not developed course content or inservice content based on research of students' and teachers' perceptions as to what are important tasks. In light of the findings of this research of students' and teachers' perceptions as to what are important tasks, it is recommended that colleges and universities responsible for inservice and undergraduate programs develop and implement programs for teachers that reflect tasks that are perceived by teachers, administrators, parents, and students as being tasks of high importance and require a high degree of professional expertise in specialized skills necessary to work with students.

6. The institutions of higher education should develop

intern programs with schools to enable the new teacher and the professional teacher who is inservicing, to work with students in different settings to gain an understanding of the high school student.

7. It is recommended that this study be replicated in part analyzing specifically algebra aptitude as measured by Iowa Test of Educational Development and Iowa Algebra Aptitude Test against the grades received by the students in the introductory algebra course. It was noted when reviewing the findings that several students with exceedingly high aptitude scores received low achievement scores and students with low to average scores were receiving high achievement scores. It was also noted that the high aptitude scores seemed to correlate with the males and females had the lower aptitude scores but higher achievement scores.

The implications of this study on the direction of future programs for instructional curriculum and teaching procedures for teachers indicate that greater emphasis should be placed on the skills necessary to work with students in the process of learning. Curriculum revision should include the teacher, institutions of higher learning, community expectations, and student perceptions of what is to take place in the classroom.

The study indicates that when developing curriculum programs for high school students teachers should take into account that effective teachers must know their students'

abilities, perceptions, and skills and plan appropriate learning activities for them. Teachers must have well organized and well managed classrooms. Students must perceive what is expected in all phases of the educational process in the classroom. If the student is aware of the teachers' expectations, then the classroom environment should be conducive to effective learning. Special care should be exercised in the development of the curriculum to cope effectively with the differences in perceptions of teachers and students.

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APPENDIX A

TEACHING-LEARNING PROCESS ANALYSIS INVENTORY

TEACHER FORM AA

Identification Number

TEACHING-LEARNING PROCESS ANALYSIS INVENTORY

TEACHER FORM AA

The inventory is designed to determine the amount of time which is spent in classroom activities. In some statements you will be asked what time you would prefer to spend.

DIRECTIONS: In describing this Algebra class, you are to circle the amount of time you think is spent with the activity listed. Select one of the indicators of time on the right which you feel best describes the activity in your Algebra class. Do not be concerned that the time indicators in different activities may not total 100%, but consider each activity separately.

EXAMPLE	TIME INDICATORS
IN THIS CLASS...	
21 ...I have my students go to the blackboard for written work	1 2 3 4 5
22 ...I would prefer to work with my slow students	1 2 3 4 5
23 ...I have my students do special reading as background for classwork	1 2 3 4 5

For each question select your answer from the five choices. Then circle the number of your choice.

1) 0 to 5% of the time
2) 5% to 33% of the time
3) 33% to 66% of the time
4) 66% to 95% of the time
5) 95% to 100% of the time

In the example, one teacher answered three statements about activities. The teacher thought that the amount of time spent in having students go to the blackboard for written work was 66% to 95% of the time so the teacher answered by circling the 4 for question 21. In question number 22 the teacher thought that the amount of time he would prefer to work with slow students was 5% to 33% of the time so the teacher circled the 2 for question 22. In question number 23 the teacher thought that the amount of time spent having students do special reading as background for classroom was 33% to 66% of the time so the teacher circled the 3 for question 23.

Arno H. Luker
Eugene D. Koplitz

Charles W. McLain
Jack Shaw

As revised by: Guerin Fischer and Charles Walker

PART I Questions 1 - 40

IN THIS CLASS	TIME INDICATORS CIRCLE ONE ONLY
1 ...I would prefer to do all of the planning of assignments and class activities	1 2 3 4 5
2 ...I would prefer having each student work with me in planning his individual assignments and class activities	1 2 3 4 5
3 ...I would prefer having the whole class work with me in planning assignments and class activities	1 2 3 4 5
4 ...I feel that the whole class would prefer to work whit me in planning assignments and class activities	1 2 3 4 5
5 ...the students work the way they do in class because they feel they are helping themselves	1 2 3 4 5
6 ...my students are listening to me or watching me demonstrate	1 2 3 4 5
7 ...the work is too difficult rather than about right for the students of this age and grade	1 2 3 4 5
8 ...the students' work suffers because they lack necessary experience and background	1 2 3 4 5
9 ...I am really interested in getting started and working on class activities	1 2 3 4 5
10 ...I feel that the students are interested in getting started and working on class activities	1 2 3 4 5

For each question select your answer from the five choices below. Then circle the number of your choice.

1) 0 to 5% of the time
2) 5% to 33% of the time
3) 33% to 66% of the time
4) 66% to 95% of the time
5) 95% to 100% of the time

IN THIS CLASS...	TIME INDICATORS CIRCLE ONE ONLY
11 ...I dislike starting the class and I look forward to its end	1 2 3 4 5
12 ...I feel that the students dislike starting the class and look forward to its end	1 2 3 4 5
13 ...individual assignments and activities are provided for various members of the class to allow for differences in interests, backgrounds, and experiences	1 2 3 4 5
14 ...I feel that the assignment and activities are of practical value to my students	1 2 3 4 5
15 ...I try to give my students practice in looking for places where they might use outside the classroom what they have learned	1 2 3 4 5
16 ...I try to give my students practice in understanding how they might wrongly use outside the classroom what they have learned	1 2 3 4 5
17 ...I would prefer to have my students work alone without consulting or talking with me	1 2 3 4 5
18 ...I would prefer to have my students work alone but with the right to consult or talk with me	1 2 3 4 5
19 ...I would prefer to have my students work alone but with the right to consult or talk with other students when they wish	1 2 3 4 5

For each question select your answer from the five choices below. Then circle the number of your choice.

1) 0 to 5% of the time
2) 5% to 33% of the time
3) 33% to 66% of the time
4) 66% to 95% of the time
5) 95% to 100% of the time

IN THIS CLASS...	TIME INDICATORS CIRCLE ONE ONLY
20 ...I would prefer to have my student work co-operatively in small groups	1 2 3 4 5
21 ...my students are satisfied with class activities and assignments	1 2 3 4 5
22 ...the class members are permitted to explore and to talk freely about their feelings about this class	1 2 3 4 5
23 ...the students discuss their feelings about this class	1 2 3 4 5
24 ...the students discuss in class their feelings about themselves and their feelings about each other	1 2 3 4 5
25 ...the students discuss in class ways of getting along with each other and ways of feeling more pleasant about themselves and others	1 2 3 4 5
26 ...I lecture or give demonstrations without allowing the students to discuss or ask questions	1 2 3 4 5
27 ...I permit students to discuss or ask questions while I am lecturing or giving demonstrations	1 2 3 4 5
28 ...my students have to memorize facts or other materials	1 2 3 4 5

For each question select your answer from the five choices. Then circle the number of your choice.

1) 0 to 5% of the time
2) 5% to 33% of the time
3) 33% to 66% of the time
4) 66% to 95% of the time
5) 95% to 100% of the time

IN THIS CLASS...	TIME INDICATORS CIRCLE ONE ONLY
29 ...I am available to give help when students desire help	1 2 3 4 5
30 ...I help students think through and work out their own difficulties or problems when they ask me for help	1 2 3 4 5
31 ...the students feel relaxed and happy as they go about doing their class work	1 2 3 4 5
32 ...students talk about their problems and get rid of their unpleasant feelings	1 2 3 4 5
33 ...we talk about how the students feel about what they learn	1 2 3 4 5
34 ...we talk about how the students' ideas are changing	1 2 3 4 5
35 ...we talk about how these changes will affect the student later in life	1 2 3 4 5
36 ...my students take tests to decide what grade they will get in class	1 2 3 4 5
37 ...my students are happy to get back tests they have taken	1 2 3 4 5
38 ...I work with my students to discover the errors they have made during tests	1 2 3 4 5

For each question select your answer from the five choices. Then circle the number of your choice.

1) 0 to 5% of the time
2) 5% to 33% of the time
3) 33% to 66% of the time
4) 66% to 95% of the time
5) 95% to 100% of the time

IN THIS CLASS...	TIME INDICATORS CIRCLE ONE ONLY
39 ...I work with my students to help them understand what they did wrong and why they made errors during tests	1 2 3 4 5
40 ...my students would prefer to take tests	1 2 3 4 5

For each question select your answer from the five choices. Then circle the number of your choice.

1) 0 to 5% of the time
2) 5% to 33% of the time
3) 33% to 66% of the time
4) 66% to 95% of the time
5) 95% to 100% of the time

Thank you for your time and consideration.

APPENDIX B

TEACHING-LEARNING PROCESS ANALYSIS INVENTORY

STUDENT FORM A

Identification Number

TEACHING-LEARNING PROCESS ANALYSIS INVENTORY

STUDENT FORM A

The inventory is designed to determine the amount of time which is spent in classroom activities. In some statements you will be asked what time you would prefer to spend.

DIRECTIONS: In describing your algebra class, you are to circle the amount of time spent with the activity listed. Choose one of the five numbers (indicators of time) shown on the right which you feel best describes the activity. The time indicators in different activities may not total 100%, and it is not necessary that they must.

EXAMPLE	TIME INDICATORS
For each question select your answer from the five choices listed on the right. Circle the number of your choice.	1) 0 to 5% of the time 2) 5% to 33% of the time 3) 33% to 66% of the time 4) 66% to 95% of the time 5) 95% to 100% of the time

IN THIS CLASS...	CIRCLE ONE
21 ...we go to the blackboard for written work.....	1 2 3 4 5
22 ...I would prefer to work with other students.....	1 2 3 4 5
23 ...we do special reading as background for classwork...	1 2 3 4 5

In the example, one student answered three statements about activities. The student thought that the amount of time spent in having students go to the blackboard for written work was 66% to 95% of the time so the student answered by circling the 4 for question 21. In question number 22 the student thought that the amount of time he would prefer to work with other students was 5% to 33% of the time so the student circled the 2 for question 22. In question number 23 the student thought that the amount of time spent having students do special reading as background for classwork was 33% to 66% of the time so the student circled the 3 for question 23.

Arno H. Luker
Eugene D. Koplitz
Jack Shaw
Charles W. McLain

As revised by: Guerin Fischer and Charles Walker

PART I QUESTIONS 1 - 40

For each question select your answer from the five choices listed on the right. Circle the number of your choice.

1) 0 to 5% of the time
2) 5% to 33% of the time
3) 33% to 66% of the time
4) 66% to 95% of the time
5) 95% to 100% of the time

	IN THIS CLASS...	TIME INDICATORS CIRCLE ONE ONLY
1	...I would prefer to have the teacher do all of the planning of assignments and class activities.....	1 2 3 4 5
2	...I would prefer to work with the teacher in planning my own individual assignments and class activities....	1 2 3 4 5
3	...I would prefer having the whole class work with the teacher in planning activities and class activities....	1 2 3 4 5
4	...I feel the whole class should work with the teacher in planning assignments and class activities.....	1 2 3 4 5
5	...I work the way I do in the class because I feel I am helping myself..	1 2 3 4 5
6	...we are listening to the teacher or watching the teacher demonstrate....	1 2 3 4 5
7	...the work is too difficult rather than about right for me and the students of my age and grade.....	1 2 3 4 5
8	...my work suffers because I lack necessary experience and background..	1 2 3 4 5
9	...I am really interested in getting started and working on class activities.	1 2 3 4 5
10	...I feel that the teacher is interested in getting started and working on class activities.....	1 2 3 4 5
11	...I dislike starting the class and I look forward to its end.....	1 2 3 4 5
12	...I feel that the teacher dislikes starting the class and looks forward to its end....	1 2 3 4 5
13	...individual assignments and activities are provided for various members of the class to allow for differences in interests, backgrounds, and experiences.....	1 2 3 4 5

For each question select your answer from the five choices listed on the right. Circle the number of your choice.

1) 0 to 5% of the time
2) 5% to 33% of the time
3) 33% to 66% of the time
4) 66% to 95% of the time
5) 95% to 100% of the time

	IN THIS CLASS...	TIME INDICATORS CIRCLE ONE ONLY				
14	...I feel my assignments and class activities are of practical-useful value to me.....	1	2	3	4	5
15	...the teacher tries to give us practice in looking for places where we might use outside the classroom what we have learned..	1	2	3	4	5
16	...the teacher tries to give us practice in understanding how we might wrongly use outside the classroom what we have learned.....	1	2	3	4	5
17	...I would prefer to work alone during the class period without consulting or talking with the teacher.....	1	2	3	4	5
18	...I would prefer to work alone but with the right to consult or talk with the teacher.....	1	2	3	4	5
19	...I would prefer to work alone but with the right to consult or talk with my classmates when I wish.....	1	2	3	4	5
20	...I would prefer to work cooperatively with small groups of classmates.....	1	2	3	4	5
21	...I am satisfied with the class activities and assignments.....	1	2	3	4	5
22	...other class members and I are permitted to explore and to talk freely about our feelings about this class.....	1	2	3	4	5
23	...my classmates and I discuss our feelings about this class.....	1	2	3	4	5
24	...my classmates and I discuss in class our feelings about ourselves and our feelings about each other.....	1	2	3	4	5
25	...my classmates and I discuss in class ways of getting along with each other and ways of feeling more pleasant about ourselves and others.....	1	2	3	4	5

For each question select your answer from the five choices listed on the right. Circle the number of your choice.

1) 0 to 5% of the time
2) 5% to 33% of the time
3) 33% to 66% of the time
4) 66% to 95% of the time
5) 95% to 100% of the time

	IN THIS CLASS...	TIME INDICATORS CIRCLE ONE ONLY
26	...we listen to the teacher lecture or give demonstrations without a chance to discuss or ask questions.....	1 2 3 4 5
27	...we are permitted to discuss or ask questions while we are listening to the teacher lecture or give demonstrations.....	1 2 3 4 5
28	...we have to memorize facts or other materials.....	1 2 3 4 5
29	...the teacher is available to give me help when I desire help.....	1 2 3 4 5
30	...the teacher helps me think through and work out my own difficulty or problems when I ask the teacher for help.....	1 2 3 4 5
31	...my classmates and I feel relaxed and happy as we go about doing our class work.....	1 2 3 4 5
32	...we talk about our problems and get rid of our unpleasant feelings.....	1 2 3 4 5
33	...we talk about how we feel about what we learn.....	1 2 3 4 5
34	...we talk about how our ideas are changing.	1 2 3 4 5
35	...we talk about how these changes will affect us later in life.....	1 2 3 4 5
36	...we take tests to decide what grade we will get in class.....	1 2 3 4 5
37	...I am happy to get back a test I have taken.....	1 2 3 4 5
38	...the teacher works with us to discover the error we have made during tests.....	1 2 3 3 5
39	...the teacher works with us to help us understand what we did wrong and why we made errors during tests.....	1 2 3 4 5
40	...I would prefer to take tests.....	1 2 3 4 5

APPENDIX C

IOWA ALGEBRA APTITUDE TEST

Examiner's Manual

by H. A. Greene and Darrell Sabers

Iowa Algebra Aptitude Test
Third Edition

Contents

SECTION ONE

Introduction

Teachers and supervisors of instruction have long been aware of the large number of pupil failures in certain school subjects. First-year algebra is one of the subjects in which the failure rate has been particularly noticeable. The difficulty which some students of first-year algebra encounter also shows itself in the large amount of extra help required by many pupils before and after school hours. There is no question that in many high schools this demand on the teacher's time is a problem of real importance. Moreover, pupils who experience difficulty with their work in algebra often allow this subject to monopolize their efforts at the expense of their other courses. Thus, problems in this area may contribute to lower achievement in other areas.

It would be a move in the direction of greater educational efficiency if certain pupils were definitely guided away from such a subject, especially if it has little importance for their post high school plans. In other cases, pupils might be well advised to postpone taking algebra until deficiencies are overcome or the pupil is more mature. Frequently the pupil (and/or parent) is allowed to choose between algebra and an alternative mathematics course. Since algebra has been part of the high school program leading to college entrance, parents often resist the notion that their child should be discouraged from taking the course. Parents may object to a selection procedure based on teacher or counselor judgment, scores from an intelligence test, or performance on an achievement test battery, even when statistical data verify the validity of the procedure. They may be more inclined to accept the recommendation of school personnel, however, if the advice is based in part on a test obviously devised for guidance in decisions about mathematics. Parents and students might have a less rigid attitude toward a placement system which employs a special aptitude test.

The introduction of new content into the high school mathematics curriculum—set theory, the theory of the number system, abstract formulations of arithmetical operations, and the like—has posed new challenges to the high school counselor. In some schools, "modern" mathematics courses are offered on a limited basis, with alternative courses such as traditional algebra or consumer mathematics being retained for those not "qualified" for the more sophisticated, abstract material. Other schools report that they offer traditional algebra to the more capable students and general mathematics courses to those less capable. In both cases there is a need for reliable guidance information whereby the successes and failures of pupils may be anticipated with considerable accuracy. It is precisely this purpose which the Iowa Algebra Aptitude Test is designed to serve.

SECTION TWO

The Construction of the Test

The Iowa Algebra Aptitude Test was first published in 1931 and a Revised Edition appeared in 1942. Both editions consisted of four separately-timed subtests: Arithmetic, Abstract Computation, Numerical Series, and Dependence and Variation. The first edition of the Iowa Algebra Aptitude Test was the result of a critical experimental study of a group of general tests as guidance instruments in first-year algebra.[1] The second edition differed from the original in that it could be machine-scored or rapidly scored by hand through the use of a stencil key.

The need for a further revision was strongly suggested by an unpublished study done in 1962-63. One of the purposes of this study was to determine, via an item analysis of the exercises in the second edition, whether or not any items were in need of revision or replacement. In this study, the Iowa Algebra Aptitude Test (Revised Edition) was administered in May of 1962, and the Lankton First-Year Algebra Test in May of 1963, to 1,130 first-year algebra students in Iowa. The students were divided into three groups on the basis of their scores on the Lankton test. The first group consisted of those students whose scores placed them in the upper 27 per cent; the second group included those students who scored in the lower 27 per cent; and the third group was composed of the balance of the students. Item statistics were obtained from the scores of the upper and lower groups. A multiple regression analysis was made of the part scores and the criterion scores.

[1] Piper, A. H. "The Validity of Certain General and Special Tests for Prognosis in First Year Algebra." Master's Thesis. State University of Iowa, 1929.

An inspection of the item data and subsequent analyses led to the following conclusions:

1. The arithmetic subtest score added little to the accuracy with which algebra achievement could be predicted.
2. The item analysis and regression analysis substantiated the value of the other three subtests. The data suggested, however, that individual items might be replaced by more discriminating exercises of the same general type.
3. A greater number of lower group students than upper group students had finished some of the subtests. This was true even though the percentage of correct responses among the upper group was relatively high. Apparently the upper ability students were able to work the exercises when allowed sufficient time. The lower ability students, on the other hand, appeared more willing to guess or mark answers at random than were the upper ability students. Thus, it appeared desirable to shorten the test to allow more time for the students to complete each part.

On the basis of these analyses, a pool of new items was prepared and tried out. When a new exercise appeared to be superior to one of the older exercises, the substitution was made. In addition to these changes, the items were rewritten to reflect present day terminology.

The retained subtests contained three kinds of items: sequences, open phrases, and dependence and variation. The first of these presents the student with a sequence of numbers and requires him to identify the next term in the sequence. In the Revised (second) Edition these items had included an alternative "not given." It seemed possible that a student might find an unanticipated but valid rule for the given sequence which produced, as its next term, a value not included among the responses. To reduce this possibility, however unlikely, the "not given" response was replaced in the third edition by a specific answer similar to the others.

Part 3, Open Phrases, was only slightly revised from the previous subtest, Abstract Computation. The subtest was shortened and reworded to use the present-day vocabulary, but no "modern mathematics" terminology that would be meaningless to some students was included.

The decision was made to retain all ten items in Part 4, Dependence and Variation. Since decreasing the length of such a short test might seriously affect its usefulness, it was considered more appropriate to reduce the importance of speed by allowing more time than had previously been allotted to this subtest. The directions were completely revised and items reworded to reflect more current terminology.

Several criteria were considered in designing a new subtest to replace the Arithmetic subtest. First, it was considered essential to include material which, on a logical basis, appeared to have high predictive validity potential. Second, the test was to be somewhat different from the existing subtests. Third, the new subtest was to exhibit a potential for predicting success in a modern mathematics program.

A number of item types which might meet these criteria were considered. The third criterion demanded an introspective analysis of possibly unique elements represented in modern high school mathematics. Logical analysis of the newer programs suggested that the student is faced with a task analogous to that of a student commencing the study of a foreign language. In part, he must master a new symbolic language. He must comprehend, through illustrations and a discussion of abstract principles, how symbols are used, how they are related, and how they may be used to represent ideas that may be new and novel to him. Much of this learning must be absorbed from the printed page.

This analysis of the learning activities in modern mathematics suggested the potential format of a new subtest. It was designed to be a series of short lessons in mathematics, each followed by a set of exercises measuring what the student had learned from reading the lesson. To insure that no student had directly studied the test material and would have to learn new material during testing, these lessons involved ideas not studied in junior high school. It was considered important that the student not be forced to memorize the content of the lessons. The decision was made, therefore, to allow the student to refer to the lesson as often as he wished as he worked the exercises. In this way the new subtest would reproduce the learning situation which he would subsequently encounter in his mathematics class.

After additional experimentation, the following subtest lengths were established:

Part	Title	Number of Items	Minutes Allowed
1	Sequences	34	14
2	Lessons	16	12
3	Open Phrases	20	10
4	Dependence and Variation	10	4
Total		80	40

SECTION THREE

Validity, Reliability, and Standardization

Validity

Validity may be thought of as an expression of the degree to which the test measures the student qualities or abilities which the test user wishes to evaluate. The validation of an achievement test is usually established in terms of the consistency between two sets of skills, abilities and knowledge: those which the student demonstrates in taking the test and those developed in the course of study. The validation of an aptitude test poses a distinctly different problem. In this case, the test must be validated in terms of its power to identify and measure abilities which underlie successful work in the given field. The validation must be quite largely experimental in character. That is, the final proof of the validity of an aptitude test rests in its power to suggest the examinee's level of success in a particular field before he has had any opportunity for direct learning in the field. This means that validity depends on the demonstrated relationship between the test scores and subsequent level of achievement. A common method of summarizing this relationship is through the correlation coefficient between test scores and achievement measures.

A comprehensive study was made of the predictive validity of the Third Edition of the Iowa Algebra Aptitude Test.[1] The IAAT was administered to the eighth grade pupils in 15 school systems in Iowa. Three criterion measures were later obtained for students who had completed one semester of algebra or modern mathematics.[2] The first of these measures was a score on an achievement test designed to cover material in a first semester course. For this purpose, two achievement tests were developed; one for modern mathematics and one for traditional algebra. Each teacher in the study determined which achievement test was appropriate for his students. The second measure was the overall mark the student received upon completion of the first semester's work. The third was a mark representing the teacher's assessment of the student's competence in the subject, disregarding such factors as tardiness of assignments, neatness of work, and other personality factors. This latter mark was considered a better measure of achievement than the regular mark, and was used with the achievement test score as a preferable criterion for evaluation of the predictive accuracy of the IAAT.

Of the 1,369 students who took the IAAT as eighth graders, 613 took courses in the ninth grade which were classified by the teachers as modern mathematics, 380 took courses classified as traditional algebra by the teachers. The correlations between the IAAT and the two achievement measures are reported in Table 1. One can observe that the correlations of the IAAT scores with the achievement test scores were higher than the correlations with the teachers marks: .78 vs. .69 for modern mathematics, .75 vs. .64 for traditional algebra. The correlations with marks may be lower than those with the achievement test scores as a result of the lower reliability of the teachers' marks. The achievement tests had reliabilities estimated at .85 and .84 (Kuder-Richardson formula 20) which are higher than those usually associated with teachers' marks.

Table 1

Validity Data for the Iowa Algebra Aptitude Test

	Modern Mathematics	Algebra
Number of students	613	380
Correlation of IAAT and achievement tests	.78	.74
Correlation of IAAT and teachers' marks	.69	.64
IAAT raw score mean	53.6	52.0
IAAT raw score standard deviation	12.5	12.1

In interpreting the coefficients reported in Table 1, it should be recognized that some of the students who took the IAAT did not enroll in either algebra or modern mathematics. These students tended to score lower on the IAAT than did pupils who later enrolled in one of the mathematics courses. Thus, the scores on which the correlations in Table 1 are based are less variable than the scores of the total experimental sample. Therefore, the accuracy of predictions from the IAAT is probably somewhat greater than that suggested by the correlations in Table 1.

Table 2 presents the correlations obtained within the individual schools. The pooled within-school coefficient is a weighted average of these coefficients, and differs from the total group coefficient reported in Table 1. The pooled within-school coefficient does not reflect school to school differences.

In interpreting the coefficients in Table 2, one must remember that the individual school groups on which these coefficients are based are even less variable than the groups considered in Table 1. Within four schools, some students were placed in a modern mathematics program while other students took algebra courses.[3] This resulted in more homogeneous groups and tended to make these coefficients lower than would have been the case if only one math program had been offered. In school

[1] Sabers, Darrell L., "A Study of the Predictive Validity of the Iowa Algebra Aptitude Test for Prognosis in Ninth Grade Modern Mathematics and Traditional Algebra," Ph.D. Thesis, The University of Iowa, 1967.

[2] To insure that the criterion scores were determined independently of the Aptitude Test scores, no tests were scored until all marks were obtained.

[3] The basis for selection in these schools is unknown, but it was not on the basis of the IAAT scores.

number 3 in the algebra group, where only the very poor students took the algebra course, the IAAT correlated only .10 with the achievement test scores. That this group is markedly different from the other school groups is obvious from the mean score (35.4) on the IAAT for these students. These data suggest that the overall coefficients reported in this manual may not be applicable to all groups. Schools which group pupils homogeneously in mathematics courses will find a lower correlation between test scores and achievement measures than schools which do not follow such grouping practices.

The results summarized in Table 1 and 2 indicate that the IAAT has a relatively high correlation with each criterion in both traditional algebra and modern mathematics. Since the IAAT was administered in May, 1966, and the criterion measures were obtained in February, 1967, there is evidence that the test provides the basis for fairly accurate prediction of achievement over a period of nine months.

The usefulness of an aptitude test such as the IAAT is determined in part by how much information it adds to that already available to the counselor or teacher in guiding students regarding placement in mathematics. The most valuable test will give information about the student that the school would not otherwise obtain. If the school has scores on a large battery of tests and previous grades earned by the student, it may well be that little new information is gained by the administration of a special aptitude test. Thus, one aspect of the validation study was concerned with the practical usefulness of the IAAT when scores on the IOWA TESTS OF BASIC SKILLS, (ITBS) were available. The ITBS arithmetic and composite scores were obtained for each student, and these were subjected, along with the IAAT scores, to a multiple regression analysis.

It was found that the IAAT was the best single predictor of success, and also that it made a statistically significant contribution to the prediction of success in both modern mathematics and algebra. It should be noted, however, that the practical increase in predictive accuracy was not great. Thus, any school having scores on a large battery of tests may find that, from the point of view of increase in predictive accuracy, the special aptitude test is a "luxury item." As has been mentioned earlier, however, parents and students may have a more accepting attitude toward a placement system that employs a special aptitude test.

In the validation of the IAAT, possible weighting of subtests and correction for guessing were studied in detail. It was found that employing the correction for chance success (along with the directions discouraging guessing on the part of examinees) did not add to the predictive efficiency of the test. Also, it was found that different weightings (that is, optimal least squares weights) of the subtest scores did not significantly increase the predictive accuracy of the IAAT. It appears that little is to be gained from separate consideration of the scores of the IAAT, hence no norms are given for part scores.

Reliability

The reliability coefficient of a test is an expression of the consistency with which the test measures those abilities

Table 2

Within-school Validity Data for the Iowa Algebra Aptitude Test

Modern Mathematics

Number of Students in Modern Math	Correlation of IAAT and Achievement Test	IAAT Raw Scores Mean	IAAT Raw Scores Standard Deviation
92	.75	55.8	9.1
38	.75	58.7	9.9
206	.80	49.8	13.2
24	.63	58.1	8.3
22	.69	48.9	8.2
50	.76	61.0	8.7
23	.63	62.3	8.0
77	.55	60.1	8.3
81	.78	45.4	13.9
Pooled within-school	(.74)	(53.6)	(12.5)

Algebra

Number of Students in Algebra	Correlation of IAAT and Achievement Test	IAAT Raw Scores Mean	IAAT Raw Scores Standard Deviation
38	.72	56.1	11.4
76	.75	51.3	11.8
25	.10	35.4	6.1
26	.47	56.0	6.2
77	.58	44.3	9.7
31	.66	59.6	9.4
17	.74	53.9	11.4
20	.56	53.9	7.7
72	.78	58.7	10.1
Pooled within-school	(.67)	(52.0)	(12.1)

or aptitudes which it does measure. The higher the reliability coefficient (that is, the nearer it comes to 1.00) the more likely are the scores to reflect the students' true level of ability. It is most important that a test used in individual guidance have high reliability.

The method used to estimate the reliability of the IAAT was the split-halves (Spearman-Brown) procedure. In this approach, the even-numbered items and the odd-numbered items were separately scored and the correlation obtained between these scores. The resultant coefficient was then substituted in the Spearman-Brown prophecy formula to obtain an estimate of the reliability of the 80-item test.

The reliability of the IAAT was estimated separately for two groups of students: those who participated in the validation study, and a sample of 1,870 students from the national standardization group. The reliability coefficients for each part and for the total score are reported in Table 3.

Table 3

Spearman-Brown Estimates of the Reliabilities of the Iowa Algebra Aptitude Test

	Validation Group (n=1369)			Norm Group (n=1870)		
Part	mean	s.d.	rel.	mean	s.d.	rel.
1	22.7	5.8	.88	19.4	6.9	.90
2	9.3	3.9	.74	7.1	4.0	.69
3	12.5	3.9	.75	10.0	4.1	.77
4	5.9	2.4	.67	4.7	2.3	.70
Total	50.4	13.4	.94	41.3	15.1	.93

Two conditions must prevail if this procedure is to give a fair estimate of the reliability: 1) the odd and even numbered items must form comparable tests, and 2) the students must have time to attempt nearly all the items.

Each of the three subtests 1, 3, and 4 is composed of homogeneous items arranged in order of increasing difficulty. Thus, the odd-even split was considered appropriate in defining halves for these subtests. The other subtest, Part 2, is composed of four sets of exercises. For this part, the first and second sets were included with the even items and the third and fourth sets were included with the odd items.

That speed was not an important factor in any of the subtests is indicated by the fact that 90 per cent or more of the pupils had finished each subtest when time was called. The average number of items omitted was less than four items per pupil for the total test.

The reported reliabilities for the total score, .94 and .93, are quite high for a test requiring forty minutes. This degree of reliability may be considered acceptable for an instrument used in reaching decisions about individuals. However, as in the case of all test scores, the user is urged to corroborate the implications of the scores by reviewing the pupil's entire cumulative record. Every test—no matter how reliable—may mismeasure some pupils. Only by careful study of all the facts can such instances be recognized.

Quite naturally, the reliability of the part scores is not as high as that of the total. However, it is not intended that these part scores be used for diagnostic purposes. Hence, reliability data for these scores is not so important as that for the total.

To indicate the degree to which the four parts measure somewhat different abilities, the intercorrelations are presented in Table 4.

Table 4

Intercorrelations of the Part & Total Scores on the IAAT (n=1,870)

	Part 1	Part 2	Part 3	Part 4	Total
Part 1		.67	.67	.59	.91
Part 2	.67		.71	.60	.86
Part 3	.67	.71		.66	.87
Part 4	.59	.60	.66		.76
Total	.91	.86	.87	.76	

A useful index of the reliability of a test is the probable error or the standard error of measurement. Table 5 presents the probable and standard errors of measurement for various score levels on the IAAT. As an example of the use of the probable error of measurement, consider a group of students who have the total score of 45. The probable error of measurement associated with this score is approximately 2.8 score points (see Table 5). The chances are even (fifty-fifty) that a student from this group has a "true score" which lies within 2.8 score points of 45. Thus we may want to think of his true ability as being between 42 and 48.

Table 5

Estimates[4] of the Standard Errors of Measurement and the Probable Errors of Measurement for the Iowa Algebra Aptitude Test

IAAT Raw Score	S.E. Measurement	P.E. Measurement
75	2.0	1.3
65	3.2	2.2
55	3.8	2.6
45	4.1	2.8
35	4.1	2.8
25	3.8	2.6
15	2.2	3.2
Average	3.8	2.6

[4]Keats' Adaptation Lord's Formula. Keats, John A., "Estimation of Error Variances of Test Scores," Psychometrika, Vol. 22, No. 1, March, 1967, pp. 29-41.

An interval obtained by adding and subtracting one standard error to and from the student's score has a greater probability of defining his "true level." The interval so formed has two chances out of three of correctly specifying his "true level." For example, for a student who scores 50 on the test, we obtain an interval of 46 and 54 (approximately). We may say, then, that the chances are approximately two-out-of-three that his "true" score lies between 46 and 54. To make a more definite statement about the level of a pupil's true score, one might wish to add and subtract an amount equal to twice the standard error.

When we obtain this wide interval, the odds are about twenty-to-one that the interval contains his true score. Thus, we feel relatively certain that the pupil who scores 25 has a true score between 17 and 33. It is well to remember that in a class of thirty-five pupils we can expect one or two students to have true scores which lie outside the interval of two standard errors. There is no way to determine which students, if any, have been mismeasured by this amount. Review of previous test results, grades, and other data may give clues to such cases, however.

Standardization

The initial aim of the national standardization was to obtain a sample of approximately 10,000 eighth grade students. Five regions of the country were chosen which are very similar to U.S. Bureau regions. Patterson's American Education[5] was used to provide a list of schools in the United States. School districts were randomly selected and the chief administrative officer and principals of buildings housing grade eight were contacted. Of the school districts initially contacted, forty agreed to participate in the study. The administrative officer of each of the larger school districts selected what was in his opinion a representative sample of eighth graders in his district. The tests were administered between January 15 and April 15, 1968. Because some school districts declined to participate in the study and the students selected within certain districts may not truly represent the population, the norms may contain an unknown bias. However, it is hoped that the norms represent a good approximation of the performance on the Iowa Algebra Aptitude Test by eighth grade students in the nation as a whole.

The norms in Table 7 are based upon the scores of 9,270 students in the national sample. The approximation of the regional distribution of students to the national census distribution is shown in Table 6.

Table 6

Per Cent of Standardization Sample by Region

	Region				
	NE	Midwest	SE	SW	W
IAAT Sample	23.2	27.9	14.3	19.3	15.2
Per cent needed	27.3	29.9	18.8	10.0	14.0

In order to establish urban-rural balance in the sample, it was desired to have 33 per cent of the pupils from communities of population less than 5,000. The obtained per cent was 32.3.

[5] Patterson's American Education, Educational Directories, Inc. (Mount Prospect, Ill., 1968) Vol. LXIII.

SECTION FOUR

Directions for Administration

If the scores on standardized tests are to be correctly interpreted, the test must be administered under carefully controlled conditions. If the directions are not followed precisely, the test norms will not be applicable and much of the value of the results will be lost. The Iowa Algebra Aptitude Test is easily administered; the directions can be followed with little or no difficulty by any teacher who is willing to study them beforehand.

A class period of 45 to 50 minutes is required for administering the test. Forty minutes of this time is actual working time for the test, leaving 5 to 10 minutes for preliminary activities, distributing materials, and the reading of directions for the separate parts of the test. To time the test, use a regular watch with a second hand, or a stop-watch if one is available.

The following suggestions may be useful to the teacher inexperienced in the giving of tests:

1. Have the pupils' desks cleared and see that each pupil is supplied with a sheet of scratch paper and at least two pencils. For machine-scoring of IBM 1230 answer sheets, No. 2 pencils are to be used. IBM 805 answer sheets must be marked with special electrographic pencils if they are to be machine-scored.
2. Follow the directions for each test carefully. See that all pupils start and stop in accordance with your sig-

nals. Each test is timed separately. Do not allow the pupils to work ahead and do not permit them to return to an unfinished subtest. If they finish before time is called, they are to wait quietly until directed to take the next test.

3. The total working time for the Iowa Algebra Aptitude test is 40 minutes. The time limits for each test-part should be followed exactly. These time limits are given on the test booklet below the title of each subtest.

Part 1	14 minutes
Part 2	12 minutes
Part 3	10 minutes
Part 4	4 minutes

Separate directions are given below for the consumable booklets and for the separate answer sheets. If separate answer sheets are to be used, but are to be hand scored, use the directions for the separate answer sheet administration.

Directions For Administration When Separate Answer Sheets Are Used

When the students are seated, check to be sure that each pupil has two (No. 2) pencils and a supply of scratch paper. (If IBM 805 answer sheets are to be machine-scored, special electrographic pencils are needed.) Do not let students use ball-point pens to mark their answer sheets. As the test booklets and answer sheets are being distributed, say to the pupils:

"Do not write on the test booklets. Do your work on scratch paper and record your answers on the special answer sheet. The answer sheets are to be scored by machine, so be careful to keep them as clean as possible. Do not fold or bend the corners, and be sure you make no stray marks on them. On the lines at the top of the answer sheet, write your name, the name of our school, and the other information requested. DO THIS NOW!"
(Pause)

(If special information is to be coded in the identification grid [IBM 1230 answer sheet only] the students should do this now. See the last page of this section for instructions.)

"Now listen carefully and follow directions. Do not begin work until I say 'GO!' This test consists of four parts. You will be told when to start and when to stop on each part. When you come to the end of each part you will see the words 'Do not turn the page until told to do so.' If you finish work on a part before time is called, you may look over your work on that part only. You may answer an exercise even though you are not absolutely sure that your answer is correct. But if you come to a problem you cannot solve, omit it and come back to it later if you have time.

"Now look at the special directions on your answer sheet. Read silently as I read these directions to you. They say: 'To mark your answer to an exercise, find the set of parallel lines numbered the same as the problem. Then blacken the space between the pair of lines which corresponds to the answer you think is correct. Fill in the space between the lines by moving your pencil point back and forth, making the mark heavy and dark. If you wish to change an answer, erase your first mark completely. Do not make stray marks on the answer sheet. If you use your pencil to keep your place on the answer sheet, rest the point on the problem number, not on the answer spaces.'

"Now place your separate answer sheet on your desk and look at the directions for Part 1 on page 1 of the test booklet. Read silently as I read these directions to you."

Part 1

"Each of the following sequences is made up according to some rule. Addition, subtraction, multiplication, division, or various combinations of these operations are used in forming each sequence. Discover the rule for each sequence and decide which of the four suggested answers is correct as the next term.

"The answers to this part are to be recorded under Part 1 on the answer sheet. The sample is answered correctly. Look at the sample and see how it is marked. (Pause for a few seconds.) You will have 14 minutes to work 34 exercises. Are there any questions? If not, ready, GO!"

At the end of fourteen (14) minutes, say "STOP. Turn to Part 2 on page 4."

Part 2

When the students have turned to Part 2, say:

"This section presents four short lessons. After each lesson is a set of exercises. Read the first lesson and work the exercises which follow before going on to the next lesson. Work each exercise and compare your answer with the suggested answers. If your answer is not among those suggested, choose answer D, 'Not Given'—meaning that the correct answer is not given.

"The answers to this part are to be recorded under Part 2 on the answer sheet. Study the sample. (Pause for a few seconds.) You will have 12 minutes to work the 16 exercises. Ready? GO!"

At the end of twelve (12) minutes, say: "STOP. Turn to Part 3 on page 6."

Part 3

When the students have turned to Part 3, say:

"The answer to each of these problems is an indicated addition, subtraction, multiplication, division, or combination of these operations. Study each problem carefully and decide what the answer is. If none of the suggested answers is equivalent to yours, choose answer D, 'Not Given'—meaning that the correct answer is not given.

"You will have 10 minutes to work the 20 problems in Part 3. Ready? GO!"

At the end of ten (10) minutes, say "STOP. Turn to Part 4 on page 8."

Part 4

When the students have turned to Part 4, say:

"Each of these exercises presents a true statement about counting numbers which are represented by the letters X, y, k, m, or s. You are to tell what must happen to X if certain changes are made in y, k, m, or s and the statement is to remain true. If there is not enough information given to decide what happens to X, choose answer D, 'Cannot Tell.'

"You will have 4 minutes to answer the 10 questions. Ready? GO!"

At the end of four (4) minutes, say "STOP. This is the end of the test."

COLLECT THE ANSWER SHEETS AND TEST BOOKLETS AT ONCE.

Directions for Administration When Consumable Booklets Are Used

When the students are seated, check to be sure that each pupil has two pencils. Do not let students use ball-point pens. After the test booklets are distributed, say to the pupils:

"On the lines at the top of your test booklet, write your name, the name of our school, and the other information requested. DO THIS NOW! (Pause)

"Now listen carefully and follow directions. Do not begin work until I say 'GO!' This test consists of four parts. You will be told when to start and when to stop on each part. When you come to the end of each part you will see the words 'Do not turn the page until told to do so.' If you finish work on a part before time is called, you may look over your work on that part only. You may answer an exercise even though you are not absolutely sure that your answer is correct. But if you come to a problem you cannot solve, omit it and come back to it later if you have time.

"You are to do your work in the test booklet. To mark your answer, blacken the letter in front of the answer you think is correct. If you wish to change an answer, erase your first mark completely.

"Now look at the directions for Part 1 on page 1 of the test booklet. Read silently as I read these directions to you."

Part 1

"Each of the following sequences is made up according to some rule. Addition, subtraction, multiplication, division, or various combinations of these operations are used in forming each sequence. Discover the rule for each sequence and decide which of the four suggested answers is correct as the next term.

"Look at the sample—the correct answer is 'C,' since 9 is the next term in the sequence. To mark the answer, the 'C' in front of the 9 should be blackened." (Demonstrate on the chalkboard.)

"You will have 14 minutes to work 34 exercises. Are there any questions? If not, ready, GO!" At the end of fourteen (14) minutes, say "STOP. Turn to Part 2 on page 4."

Part 2

When the students have turned to Part 2, say:

"This section presents four short lessons. After each lesson is a set of exercises. Read the first lesson and work the exercises which follow before going on to the next lesson. Work each exercise and compare your answer with the suggested answers. If your answer is not among those suggested, choose answer D, 'Not Given'—meaning that the correct answer is not given.

"Study the sample. (Pause for a few seconds.) You will have 12 minutes to work the 16 exercises. Ready? GO!" At the end of twelve (12) minutes, say: "STOP. Turn to Part 3 on page 6."

Part 3

When the students have turned to Part 3, say:

"The answer to each of these problems is an indicated addition, subtraction, multiplication, division, or combination of these operations. Study each problem carefully and decide what the answer is. If none of the suggested answers is equivalent to yours, choose answer D, 'Not Given'—meaning that the correct answer is not given.

"You will have 10 minutes to work the 20 problems in Part 3. Ready? GO!" At the end of ten (10) minutes, say "STOP. Turn to Part 4 on page 8."

Part 4

When the students have turned to Part 4, say:

"Each of these exercises presents a true statement about counting numbers which are represented by the letters X, y, k, m, or s. You are to tell what must happen to X if certain changes are made in y, k, m, or s and the statement is to remain true. If there is not enough information given to decide what happens to X, choose answer D, 'Cannot Tell.'

"You will have 4 minutes to answer the 10 questions. Ready? GO!" At the end of four (4) minutes, say "STOP. This is the end of the test."

COLLECT THE TEST BOOKLETS AT ONCE.

Coding Information in Identification Grid of the IBM 1230 Answer Sheet

The identification grid on the IBM 1230 answer sheets is provided for one of two purposes: to record identification numbers for students or to record other information about the students. This other information may be the marks the students have received in previous courses in math, IQ scores, or any other potential predictors of success in algebra.

If the students are to record their identification num-

bers or other information in the grid, they should be instructed to first write the numerals under the arrow at the top of the grid. The ten spaces can accommodate one ten-digit number, or five two-digit numbers, etc. After recording the numerals under the arrow, the student should blacken the space between the pair of lines which corresponds to each numeral.

If information is to be recorded for later statistical analysis, it is recommended that the statistician be consulted before the data is recorded in the grid.

SECTION FIVE

Directions for Scoring

The Third Edition of the Iowa Algebra Aptitude Test is intended for use as a reusable booklet with separate answer sheets. These answer sheets, IBM 805 or IBM 1230, are designed for machine- or hand-scoring. It is easier, faster, and more economical to hand-score the separate answer sheets than to hand-score the test booklets. However, a key is available for those who wish to use the test booklet as a consumable booklet. Note that there is only one edition of the test; it is used either as a consumable booklet or a reusable booklet with answer sheet.

The following principles should be observed in scoring the test:

1. The exercises are scored as right or wrong. No partial credit is given.
2. Pupils who make a legible correction may be credited accordingly. Any correction which makes the work illegible or doubtful should be counted as wrong. If the student has marked more than one answer space, the item is to be scored as wrong.
3. If a pupil deviates slightly in the mark he has made to record his response, but otherwise gives a correct response, it should be counted as correct. The purpose of the test is to assess the pupil's ability to respond to these particular types of exercises, not to measure his ability to follow specific directions.
4. Space is provided on the first page of the test booklet and on the answer sheets for recording the student's scores on each part of the test. However, it is generally recommended that only the total test score be used. Considerable time can be saved by obtaining only the total test score, and as was previously indicated, the part scores are not sufficiently reliable to provide accurate profile analysis.

Hand-Scoring Answer Sheets

1. Scan each answer sheet for double-marked or poorly erased items. When an answer obviously has been changed by a student, score the final response by drawing a red line through the poorly erased response. Draw a red line through all multiple-marked items so that no credit will be given for these items.
2. Place the appropriate stencil key on the answer sheet and position it so that the correct answer spaces show through the corresponding openings on the key. Each answer sheet has guide marks which will appear through holes when the stencil is correctly positioned.
3. Obtain the score by counting the number of correctly marked items appearing through the holes in the key. Follow the guidelines on the stencil key (IBM 1230 only) and do not count the double marked items that have been marked in red.
4. Enter the score in the box provided on the answer sheet.
5. Convert the score to a percentile rank by use of one of the norms tables on pages 10 or 11 of this manual (or use local norms if they are available).

Hand-Scoring Consumable Booklets

1. Before scoring each page, scan all the responses for double marked or poorly erased items. When an answer obviously has been changed by a student, score the final response. Draw a red line through the multiple-marked items so that no credit will be given for these items.
2. Place the scoring key on each respective page in the booklet and position it so that the answer spaces on the key are opposite the corresponding positions in the booklet. When the key is properly placed on the page, it will be possible to score both columns on the page without re-positioning the key.
3. Draw a red line through every correct answer space that has NOT been marked by the student.
4. When all pages in the booklet have been scanned and marked, the student's raw score is obtained by counting the total number of items having no red mark. Since there are 80 items in the test, the raw score may be obtained by subtracting the number of incorrect items from 80.
5. Enter the score in the box provided on the first page of the test booklet.
6. Convert the score to a percentile rank by use of one of the norms tables on pages 10 or 11 of this manual (or use local norms if they are available).

SECTION SIX

Making Use of the Results

Some type of norm is essential if the scores on a standardized test are to have meaning. Norms enable the user to compare the score of a particular pupil to those made by others at the same grade level. In essence, norms permit the user to judge the comparative level of performance of an examinee. In many cases, teachers and counselors may wish to compare a pupil to others who have passed through the local system, that is, they may wish to base interpretations on local norms. However, it may take a period of several years for a school system to accumulate sufficient data on which to base stable local norms. Moreover, teachers often wish to evaluate a local student in terms of his standing within a more comprehensive population—one which the teacher has never had the opportunity to observe in the classroom. For these reasons national norms are reported in Table 7. These norms represent the performance of eighth grade students near the middle of the school year.

As an example of subpopulations for whom these national norms are not appropriate, Table 8 presents percentile ranks obtained from fifteen schools in Iowa. Based on analysis of the scores of these schools in the Iowa State Testing Programs, this sample appears to be representative of the schools in Iowa. As is the case in all norm groups, there may be an unknown bias resulting from the fact that some schools refused the invitation to become part of this state norming sample.

There are many reasons why one should expect these

Table 7

Percentile Ranks and Stanines Corresponding to Iowa Algebra Aptitude Test Raw Scores

(n=9,270 eighth grade students in National Sample)

IAAT Total Score	PR	Stanine
72-79	99	9
70-71	98	9
69	97	9
67-68	96	9
66	95	8
65	94	8
64	92	8
63	91	8
62	90	8
61	89	8
60	87	7
59	86	7
58	84	7
57	82	7
56	81	7
55	79	7
54	77	7
53	75	6
52	72	6
51	70	6
50	68	6
49	66	6
48	64	6
47	61	6
46	59	5
45	56	5
44	54	5
43	52	5
42	49	5
41	47	5
40	45	5
39	42	5
38	40	4
37	38	4
36	35	4
35	33	4
34	31	4
33	29	4
32	26	4
31	24	4
30	22	3
29	20	3
28	18	3
27	16	3
26	14	3
25	12	3
24	11	2
23	9	2
22	7	2
21	6	2
20	5	2
19	4	2
18	3	1
16-17	2	1
12-15	1	1

students to score higher than the national average. The testing date for these Iowa schools was in May, whereas the national sample was tested near March 1. Mathematical maturity of the students during eighth grade will thus affect the scores. In addition, Iowa is basically a rural state with an exceptionally high literacy rate. The mobility of the population is not as great as that of many other state populations. These factors indicate that local or state norms are needed for this subpopulation of students.

Information from the Iowa schools is used to show that a student's percentile rank depends not only upon his score but also upon the group with which his performance is being compared. Table 8 illustrates this by presenting the percentile ranks of 1,363 eighth grade students in Iowa schools when compared to three groups. The percentile ranks are given for the total group and two subgroups of these students.

To illustrate the use of Table 8, consider a student receiving a total raw score of 50. Compared to all eighth grade students in Iowa, he has a PR of 46. However, when compared to those students enrolled in modern mathematics programs, his PR is 36. Thus, while it appears that this student ranks near the middle of his eighth grade class, he may be in the lower third when compared to those students who take the modern mathematics course in grade nine. In developing norms for a given school system, a counselor may wish to obtain the distribution of scores for various specific subgroups of students.

Table 9 represents an alternative method of summarizing the validity data for the IAAT. This type of summary, which is known as an expectancy table, is especially useful when the counselor and the student consider which mathematics class a student should elect. These tables were developed in the experimental study reported in the section on "Validity."

In practice, an expectancy table summarizes the distribution of grades made by pupils who scored at a particular level on the aptitude test. For example, of the forty-three students who scored 70 or higher on the IAAT and subsequently enrolled in Modern Mathematics, 9 per

Table 8

Percentile Ranks Corresponding to Iowa Algebra Aptitude Test Total Scores

(n=1,363 eighth grade students in Iowa schools)

IAAT Score	All Students	Algebra Students	Modern Math Students
76	99+	99	99
75	99	99	98
74	98	98	98
73	97	98	97
72	96	97	96
71	96	95	95
70	95	94	94
69	93	92	92
68	92	91	90
67	90	89	87
66	88	87	84
65	86	84	81
64	83	82	78
63	81	80	74
62	79	78	72
61	76	76	68
60	73	72	64
59	70	69	60
58	67	66	57
57	64	63	55
56	62	60	52
55	59	56	50
54	56	52	47
53	54	50	44
52	51	46	41
51	48	43	38
50	46	41	36
49	43	39	32
48	41	37	30
47	38	35	27
46	36	32	24
45	33	30	22
44	32	27	21
43	30	25	20
42	28	24	19
41	26	22	17
40	24	20	15
39	22	18	14
38	20	15	12
37	18	14	11
36	17	12	10
35	15	10	9
34	13	9	8
33	11	7	7
32	10	5	6
31	9	4	5
30	8	4	5
29	7	3	4
27-28	6	2	4
26	5	1	3
25	4	1	3
24	3	1	2
23	2	1	2
22	2	0	1
20-21	1		1
19	1		0

cent (four students) received "C's," 44 per cent received "B's," and 47 received "A's," as marks from their teachers. Thus, for a student who scored 70 or higher on the IAAT (and for whom Table 9 can be considered applicable) the chances are 96 in 100 that he will receive an "A" or a "B" in Algebra. In the same manner, the chances are better than even that a student with a score below 40 on the IAAT will receive a failing mark in Modern Mathematics. It must be understood, of course, that these figures represent the facts revealed in the authors' validity studies. In a particular school, the per cents might differ considerably.

To construct an expectancy table for use in his own school, the counselor need only to group the students according to IAAT total score (or any other "predictor" variable) and to tabulate a frequency distribution of the criterion marks for the students at each score level. The particular intervals used in Table 9 need not be adopted by all schools. In large schools it may be possible to use smaller intervals and still have fairly large numbers of pupils in each subgroup; smaller school counselors may elect initially to use coarse intervals and then refine the intervals as data accumulate over several years.

Many counselors may desire to combine various scores and grades with the IAAT information to predict success in mathematics. If the IAAT scores are to be used as one of a number of independent variables in a multiple regression analysis, or if a correlation coefficient between the IAAT and some criterion measure is to be computed for determining accuracy of prediction, percentile conversions of the IAAT scores should NOT be made. In any statistical analysis of the IAAT scores, it is better to use the raw scores than percentile scores.

Table 9

Per Cent of Students Receiving Each Mark
For Score Intervals of the
Iowa Algebra Aptitude Test

Modern Mathematics

Score Interval	E or F	D	C	B	A	N
70-79			09	44	47	43
60-69		05	27	48	20	189
50-59	04	15	39	33	09	173
40-49	16	32	32	19	01	121
below 40	53	26	20	01		87
N	72	98	177	192	74	613

Algebra

Score Interval	E or F	D	C	B	A	N
70-79			04	52	44	25
60-69		07	32	35	28	87
50-59		12	59	25	04	118
40-49	06	32	51	10	01	79
below 40	20	39	37	04		71
N	19	73	165	83	40	380

SECTION SEVEN

Key to Third Edition

Part 1—Sequences

1. B	6. B	11. C	16. B	21. D	26. D	31. B
2. A	7. D	12. D	17. A	22. C	27. A	32. C
3. D	8. B	13. C	18. A	23. B	28. A	33. D
4. D	9. A	14. A	19. C	24. D	29. B	34. C
5. C	10. C	15. D	20. C	25. A	30. C	

Part 2—Lessons

1. D	4. B	7. A	10. D	13. B	16. A
2. C	5. C	8. C	11. D	14. C	
3. A	6. A	9. A	12. B	15. C	

Part 3—Open Phrases

1. B	4. C	7. C	10. C	13. B	16. D	19. A
2. D	5. B	8. A	11. A	14. A	17. B	20. B
3. B	6. A	9. C	12. D	15. C	18. D	

Part 4—Dependence and Variation

1. B	4. D	7. C	10. A
2. A	5. C	8. D	
3. C	6. B	9. B	

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Communities Participating in Standardization of the Iowa Algebra Aptitude Test

ALASKA:	Ft. Greely
CALIFORNIA:	King City, Rio Vista, North Sacramento
ILLINOIS:	Glen Ellyn, Polo
INDIANA:	Alexandria, Lawrence
KANSAS:	Macksville
KENTUCKY:	Ashland
LOUISIANA:	Opelousas
MASSACHUSETTS:	North Andover
MICHIGAN:	Bridgeport, Stevensville
MISSOURI:	Ellsinore, Montgomery City
NEBRASKA:	Mullen, Rosalie
NEW JERSEY:	Linden, Nutley, Verona
NEW YORK:	Northport, Sayville
NORTH CAROLINA:	Elkin, Mount Holly
NORTH DAKOTA:	Bowbells
OHIO:	Alliance, Clyde, West Richfield
OKLAHOMA:	Okmulgee
PENNSYLVANIA:	Allison Park
RHODE ISLAND:	Wakefield
SOUTH CAROLINA:	Columbia
TENNESSEE:	Townsend
TEXAS:	Fort Stockton, Orange, Tyler
VIRGINIA:	Ararat, Fisherville
WASHINGTON:	Touchet

APPENDIX D

IOWA TESTS OF EDUCATIONAL DEVELOPMENT

Fall Testing Program for Iowa High Schools

IOWA TESTS OF EDUCATIONAL DEVELOPMENT

Iowa and National Percentile Ranks

for Pupil Scores

Forms X-7 & Y-7

1981 Revision

Iowa Testing Programs
College of Education
University of Iowa

2

The Iowa Percentile ranks are based on the scores of students who took Form X-7 or Y-7 in the 1980 Fall Testing Program. The numbers of students, classified by high school size, are indicated below.

Size Category	Grade 9	Grade 10	Grade 11	Grade 12
(A) 350 or more	21,526	16,623	22,756	13,932
(B) 200-349	6,390	5,081	6,701	4,473
(C) 199 or less	5,274	3,765	5,387	2,935
TOTAL	33,190	25,469	34,844	21,340

A total of 409 Iowa systems used Forms X-7 and Y-7 in 1980.

The national norms are based on data obtained in a national standardization program conducted by Science Research Associates in April and September, 1978. The tests were taken by 14,758 students in 89 public and private school districts. These districts were selected via a sampling procedure which gave appropriate weight to each of the nine principal geographical regions of the country. Each regional sample was chosen to reflect the full range of school sizes that exist within the region. Thus, the national sample appropriately reflected whatever regional and school size differences in achievement may hold in the United States. The national percentiles were adjusted in 1979 and 1980 to reflect the downward trend in achievement revealed by the National Assessment Program, ACT, and the College Entrance Examination Board.

Percentile Ranks for the

IOWA TESTS OF EDUCATIONAL DEVELOPMENT

Forms X-7 & Y-7

Grade 9

SS	E Express.		Q Quant.		SS Soc.Stud.		NS Nat.Sci.		L Liter.		V Vocab.		SI Sources		C Comp.		RT Reading	
	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat
28							99	99					99	99				
27							98	98					98	98				
26			99		99	99	97	97	99		99		97	97	99	99	99	
25			98	99	98	98	96	96	98	99	97		95	96	98	98	98	99
24	99	99	97	98	97	97	94	95	97	98	96	99	93	95	97	97	97	98
23	98	98	96	97	96	96	92	94	96	97	95	98	90	94	95	96	96	97
22	96	97	94	96	94	95	90	93	94	96	93	97	87	93	93	95	94	96
21	94	96	92	95	93	93	87	92	92	94	91	96	84	90	90	93	91	95
20	91	94	89	93	90	91	84	90	89	93	89	95	80	88	87	91	87	93
19	87	92	85	91	86	88	79	88	85	91	85	92	75	85	83	88	83	90
18	83	89	82	90	82	85	74	85	80	88	80	89	70	81	78	84	78	88
17	78	85	77	88	77	82	69	81	76	85	72	84	66	77	73	80	73	84
16	72	80	73	86	72	79	63	76	71	80	64	79	61	73	67	76	67	80
15	65	75	69	84	66	76	57	72	65	76	55	73	57	69	60	72	62	76
14	58	70	65	81	60	73	51	68	60	72	47	67	52	65	53	68	57	72
13	50	64	60	74	55	69	44	64	54	67	41	60	46	61	46	63	51	66
12	42	57	53	66	48	64	38	59	48	62	35	51	41	55	39	57	45	60
11	35	48	45	57	40	56	32	53	42	55	29	42	36	48	33	50	39	54
10	28	40	37	47	33	48	26	47	36	49	24	34	30	42	27	44	32	48
9	21	33	28	37	26	41	21	42	28	43	18	25	25	36	22	37	25	40
8	14	25	20	29	19	34	16	36	19	35	13	18	19	30	18	30	18	31
7	8	18	13	21	13	26	13	29	13	25	10	13	14	23	14	25	12	20
6	5	12	9	16	9	20	8	22	9	18	7	10	10	18	10	20	8	13
5	3	8	6	11	6	15	5	16	6	11	5	7	6	14	8	14	6	9
4	2	5	4	7	4	10	3	11	4	8	3	5	4	9	5	9	4	7
3	1	3	2	4	2	6	2	7	2	5	1	3	2	5	3	5	2	5
2		2	1	2	1	4	1	4	1	3		2	1	3	2	3	1	3
1		1		1		2		2		1		1		1	1	1		1

Percentile Ranks for the

IOWA TESTS OF EDUCATIONAL DEVELOPMENT

Forms X-7 & Y-7

Grade 10

SS	E Express.		Q Quant.		SS Soc.Stud.		NS Nat.Sci.		L Liter.		V Vocab.		SI Sources		C Comp.		RT Reading	
	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat
30													99	99				
29							99	99					98	98	99	99		
28			99	99	99	99	98	98					97	97	98	98		
27			98	98	98	98	96	97		99	99		96	96	97	97	99	99
26	99	99	97	97	97	97	95	95	99	98	98	99	93	95	96	96	98	98
25	98	98	96	96	96	96	92	94	98	97	96	98	90	94	94	95	96	97
24	97	97	94	95	94	95	89	92	96	96	94	97	87	92	92	94	94	96
23	96	96	91	93	91	94	86	91	94	95	91	96	83	90	89	93	92	94
22	93	94	88	91	88	92	83	90	91	93	88	94	79	88	86	92	89	92
21	89	92	84	89	86	89	79	88	88	91	85	93	74	85	82	90	85	90
20	85	88	80	87	82	87	74	86	84	89	82	91	70	81	77	87	80	88
19	80	84	75	84	78	84	69	83	77	86	76	88	64	78	72	84	74	85
18	74	79	70	81	72	81	63	80	72	82	69	83	58	74	67	79	68	81
17	68	73	65	78	66	78	57	75	68	78	60	77	53	71	60	74	62	77
16	61	67	61	74	61	74	52	70	63	73	51	70	49	67	54	69	56	73
15	54	61	57	71	55	70	46	68	55	68	42	63	44	63	47	63	51	68
14	47	54	52	67	49	66	40	65	50	63	35	55	40	58	40	58	46	63
13	39	46	46	62	43	62	34	58	44	58	29	47	35	53	34	53	41	56
12	32	38	40	55	37	56	28	51	38	52	25	38	31	48	28	46	35	51
11	26	31	33	47	30	49	23	44	32	45	20	30	26	42	23	39	30	44
10	20	25	26	38	24	42	19	38	27	38	16	23	22	36	18	33	24	37
9	14	19	19	30	19	34	14	33	20	31	12	17	17	31	14	27	18	30
8	9	15	13	23	13	26	11	28	14	24	9	13	13	26	11	22	12	23
7	6	11	8	17	9	20	8	22	9	18	7	10	9	20	8	18	8	17
6	3	7	5	12	6	15	5	18	6	13	5	8	6	16	6	14	5	12
5	2	5	4	9	4	11	3	14	4	9	3	6	4	13	4	10	4	9
4	1	3	2	6	2	8	2	9	2	7	2	4	3	8	3	7	2	6
3		2	1	4	1	5	1	5	1	5	1	2	2	5	2	4	1	4
2		1		2		3		2		3		1	1	3	1	2		2
1				1		1		1		1				1		1		1

Percentile Ranks for the

IOWA TESTS OF EDUCATIONAL DEVELOPMENT

Forms X-7 & Y-7

Grade 11

SS	E Express.		Q Quant.		SS Soc.Stud.		NS Nat.Sci.		L Liter.		V Vocab.		SI Sources		C Comp.		RT Reading	
	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat
32													99	99	99	99		
31			99				99						98	98	98	98		
30			98	99	99	99	98	99			99		96	97	97	97	99	
29			97	98	98	98	97	98	99	99	98	99	94	96	95	96	98	99
28	99		95	97	97	97	95	96	98	98	97	98	92	95	94	95	97	98
27	98	99	93	96	95	96	93	94	97	97	96	97	89	93	92	94	96	97
26	97	98	91	95	93	95	90	92	96	96	95	96	86	91	90	93	94	96
25	96	97	89	94	91	94	86	90	93	95	94	95	82	89	87	92	92	94
24	94	96	87	92	88	92	82	88	90	93	92	94	77	86	84	91	89	92
23	91	94	84	90	84	90	78	86	86	91	89	92	73	84	80	89	85	90
22	87	91	81	87	80	87	74	83	82	88	85	90	68	81	76	86	81	87
21	81	87	77	84	76	84	69	80	78	85	80	87	63	77	71	83	76	84
20	75	81	73	81	71	80	63	76	73	82	74	84	58	72	66	80	71	81
19	69	76	68	78	66	76	56	72	68	77	66	79	54	68	61	76	65	78
18	63	70	63	75	61	71	51	68	61	71	57	72	49	63	55	70	59	73
17	56	64	58	72	56	67	46	63	55	66	48	63	44	58	49	64	53	67
16	47	57	53	69	51	62	41	58	49	61	39	55	40	54	43	58	47	61
15	40	51	48	64	46	58	37	53	45	56	32	47	36	50	37	52	42	56
14	34	44	43	59	40	54	32	48	40	51	27	40	32	46	31	46	37	50
13	29	36	38	53	34	49	28	43	35	46	23	33	28	42	26	40	33	45
12	24	29	33	47	29	43	23	38	29	39	19	26	24	37	21	35	28	39
11	19	23	27	40	24	35	19	33	24	33	15	20	20	31	17	29	23	33
10	14	17	22	32	19	29	16	28	20	27	11	16	16	26	13	24	19	28
9	10	12	16	24	14	24	13	24	15	22	7	13	13	22	10	19	15	23
8	6	9	11	17	10	18	10	19	11	17	5	10	10	18	7	15	11	17
7	4	6	7	12	7	13	7	15	8	13	4	8	8	15	5	13	8	12
6	3	4	4	8	5	9	4	11	5	11	3	6	6	11	3	10	5	9
5	2	2	2	5	3	6	3	8	3	9	2	4	4	7	2	7	3	7
4	1	1	1	3	2	4	2	5	2	7	1	2	3	4	1	4	2	5
3				2	1	3	1	3	1	5		1	2	2		2	1	3
2				1		2		2		3			1	1		1		1
1						1		1		1								

Percentile Ranks for the

IOWA TESTS OF EDUCATIONAL DEVELOPMENT

Forms X-7 & Y-7

Grade 12

SS	E Express.		Q Quant.		SS Soc.Stud.		NS Nat.Sci.		L Liter.		V Vocab.		SI Sources		C Comp.		RT Reading	
	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat	Iowa	Nat
34															99	99		
33													99	99	98	98		
32			99	99									98	98	97	97		
31			98	98	99	99	99	99			99		97	97	96	96	99	
30			97	97	98	98	98	98	99	99	98	99	94	95	95	95	98	99
29	99		95	96	96	96	96	97	98	98	97	98	91	93	93	94	97	98
28	98	99	92	95	94	95	94	94	97	97	96	97	88	91	91	93	96	97
27	97	98	90	94	92	93	91	91	96	96	95	96	84	88	89	91	94	96
26	96	97	87	92	89	91	87	88	94	95	93	94	80	85	86	89	92	94
25	94	96	84	89	86	88	83	85	91	93	91	92	76	82	83	87	89	91
24	91	95	82	86	83	85	79	82	87	90	88	90	71	78	79	84	86	88
23	87	93	79	83	78	81	74	79	82	87	84	86	66	75	75	80	81	84
22	82	89	75	80	73	77	69	76	78	84	79	82	60	71	70	77	76	80
21	75	84	72	77	68	73	64	72	73	80	73	77	55	66	65	74	71	76
20	68	79	68	74	63	68	59	68	68	75	66	72	50	62	59	70	66	72
19	62	74	63	71	58	63	53	64	63	70	58	67	46	58	54	65	60	67
18	56	68	57	68	53	57	48	59	57	65	49	59	42	53	48	59	54	62
17	48	61	53	64	48	52	43	54	50	59	40	50	38	48	42	53	47	56
16	41	54	48	60	44	48	38	49	45	54	32	43	34	44	37	47	42	51
15	34	47	43	55	39	44	34	44	41	48	26	37	30	40	32	42	37	46
14	29	41	38	49	34	40	30	40	37	42	21	30	27	36	27	37	33	41
13	24	35	33	44	29	36	26	36	32	37	18	24	24	33	22	32	29	36
12	20	28	29	38	24	31	21	32	27	32	14	19	20	29	17	27	25	31
11	16	22	24	32	20	26	17	28	22	27	11	15	16	25	14	22	20	27
10	12	17	19	26	16	21	14	24	19	23	8	11	13	21	11	18	17	22
9	8	12	14	20	12	17	12	20	15	19	5	8	11	17	8	15	13	17
8	5	9	9	15	9	13	9	16	10	15	4	6	9	13	6	12	10	13
7	3	6	6	10	6	10	6	12	7	12	3	4	7	10	4	10	7	9
6	2	4	3	6	4	7	4	8	5	9	2	3	5	8	2	8	4	6
5	1	2	2	4	3	5	3	6	3	7	1	2	4	5	1	5	3	4
4		1	1	2	2	3	2	4	2	5		1	3	3		3	2	2
3				1	1	2	1	2	1	3	1		2	2		2	1	1
2						1		1		1			1	1		1		
1																		

APPENDIX E

IDENTIFICATION KEY

Identification Key

School	Number	*Teacher(s)	M	F	*Class	**Student # Example	M	F	Composite # Example
Algona	1	1			1	1			11101
		2			2	2			12202
		3			3	10			13310
		4			4	30			14430
Clarion	2	1			1	1			21101
		2			2	2			22202
		3			3	10			23310
		4			4	30			24430
Clear Lake	3	1			1	1			31101
		2			2	2			32202
		3			3	10			33310
		4			4	30			34430
Eagle Grove	4	1			1	1			41101
		2			2	2			42202
		3			3	10			43310
		4			4	30			44430
Hampton	5	1			1	1			51101
		2			2	2			52202
		3			3	10			53310
		4			4	30			54430
Iowa Falls	6	1			1	1			61101
		2			2	2			62202
		3			3	10			63310
		4			4	30			64430
Humboldt	7	1			1	1			71101
		2			2	2			72202
		3			3	10			73310
		4			4	30			74430
Webster City	8	1			1	1			81101
		2			2	2			82202
		3			3	10			83310
		4			4	30			84430

*Additional teachers or classes, exceeding four (4) should be added in numerical sequence following the same order as displayed above.

**Identification numbers are listed for each student in the class.

Student's identification numbers should correspond with alphabetical sequence in each class.

APPENDIX F

LETTER TO HIGH SCHOOL COUNSELORS

TO: High School Counselors

FROM: Albert Van Overmeer, Principal
Eagle Grove High School

RE: Perception Surveys

I am requesting that you assist in disseminating the enclosed Perception Survey. Would you please be sure that each beginning algebra student and his/her teacher receive a copy of the appropriate survey.

Each survey has forty (40) questions that should take no more than twenty (20) minutes to complete by staff or students. The classroom instructor is asked to distribute student Form A and inform the student to answer the questions to the best of his/her ability. However, the teacher is NOT to clarify questions or the meaning of words. It should be left to the student to decipher this information. The teacher's role is to be sure the instructions are clear and that the surveys are handed out in alphabetical order with corresponding identification numbers. The identity of the surveyee will not be disclosed at any time.

The survey is to be given on Tuesday of the last week of the first semester. Any student absent on the day of the survey is not to make it up. However, if a teacher happens to be absent that day, please have them complete the survey when they return, if within a week of the initial survey.

You are asked to list the scores of the Iowa Algebra Aptitude Test and the student's final semester algebra grade on the top of each survey.

I will provide a manuscript of the results to each school. To say 'thank you' is certainly inadequate in this age of paper profusion. However, I am grateful and indebted to you, and I owe you a return favor.

APPENDIX G

LETTER TO ALGEBRA INSTRUCTORS

TO: Algebra Instructor

RE: Algebra Perception Survey

FROM: Albert Van Overmeer, Principal
Eagle Grove High School

Your cooperation would be appreciated in completing a Teacher Perception Survey Form AA (blue). Additionally, we would like each of your beginning algebra students to complete a Student Perception Survey Form A (white). Please administer these surveys on the Tuesday of your last week of the first semester. The surveys will take approximately twenty (20) minutes.

Please distribute in alphabetical order and make a list which corresponds with the I.D. numbers on top of the survey form. All surveys are numbered from 01-26. Read the instructions to the students but do not provide any additional assistance. Please explain time percentages as the amount per class period.

If you need more surveys there are extras in your counselors office. Please add number 27 or 28, etc. at the bottom of the tally sheet. Do not try to code them. Return the surveys to your counselor after completion. Absent students should be voided and not recorded.

As these surveys are important to the completion of my doctorate program I do appreciate your time and efforts. A copy of the dissertation will be forwarded to your school. If you wish a computer print-out of your results please indicate that below and submit with your survey forms.

If you have any questions, please call collect 448-4134 (home) or during the day, 448-5143 (school) and I will attempt to answer your concerns.

____Print-out of my class(es) results.

APPENDIX H

TALLY SHEET

Tally Sheet

Teacher Number_______________ M____ F____

Identification Number Student/Teacher	M	F	Alg. App. Score	Grade For Semester